DEPARTMENT OF AGRICULTURE
MYSORE STATE

MYSORE AGRICULTURAL CALENDAR AND YEAR BOOK

1954

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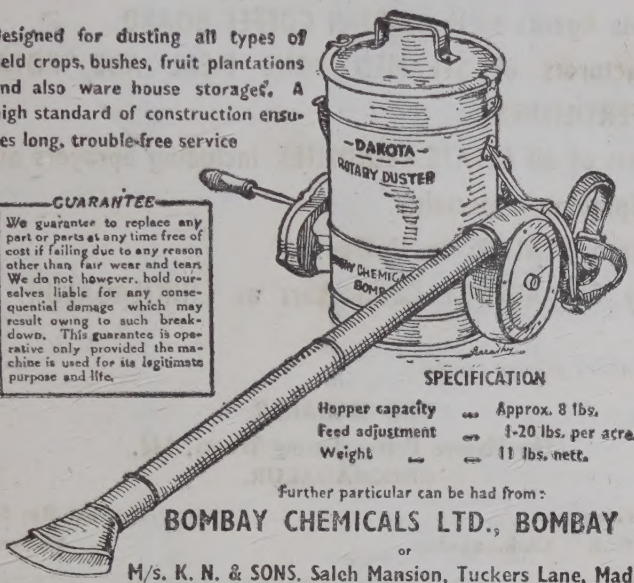

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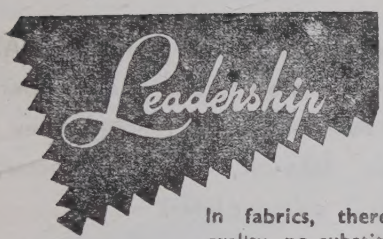

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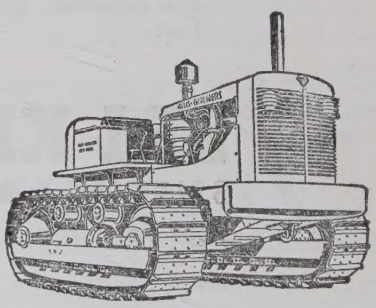

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DEPARTMENT OF AGRICULTURE, MYSORE STATE

MYSORE AGRICULTURAL CALENDAR

AND

YEAR BOOK

1954

Editor :
M. L. N. IYENGAR,
Technical Asst. to Director of Agriculture.

BANGALORE CITY
THE MODI POWER PRINTING WORKS
1954

PREFACE

THE MYSORE AGRICULTURAL CALENDAR is one of the unique agricultural publications in India. It is an almanac, handbook and year book combined. The articles in the Calendar sum up the practical results of agricultural research in a popular style.

Like many other institutions and sections, such as The Mysore Agricultural and Experimental Union, etc., in the Mysore Department of Agriculture, this Calendar was founded by the first Director of Agriculture, Dr. Leslie C. Coleman who is happily with us again in the State as this issue of the Calendar is in print.

There is considerable room for continued improvement in the contents and scope of the Calendar. With the co-operation of authors and advertisers to whom we are grateful, we have made some progress this year in making this publication an useful annual and year book. We hope to make this publication worthy of the Mysore Department and its founder.

M. K. APPAJAPPA,
Director of Agriculture.

MESSAGE FROM Dr. LESLIE C. COLEMAN TO MYSORE FARMERS

I have been asked by the Editor to write a short note for inclusion in the Mysore Agricultural Calendar and Year Book, 1954. It is now over twenty years since I last took part in the preparation of this valuable publication. In the meantime it has grown to twice its original size and has added greatly to its usefulness. The interest in the improvement of Mysore Agriculture has greatly increased during these 20 years and the number of educated agriculturists to whom the articles in the Calendar and Year Book will appeal has increased correspondingly.

I have now reached what may be looked upon as the age of wisdom. If so, my advice may be of some value. This is my advice to Mysore Agriculturists.

Make full use of the services of your Agricultural Department. Its only excuse for existence is its service to you. Remember that the Agricultural officer in your neighbourhood has a large area to cover and many villages. If he does not appear in your village and you need his services write to him or let him know. He cannot be expected to read your thoughts. Co-operate to the full with the Agricultural Department in its programme of introducing better varieties of seed, better manuring, better methods of cultivation and better means of controlling insect pests and plant diseases. Remember that if you do not co-operate enthusiastically and continuously, progress will be slow. Help the Department in every possible way to improve its survive to the agriculturists of Mysore. If you do this, I shall expect to hear of rapid progress.

Now that I am leaving Mysore I wish you all good crops and great prosperity.

Leslie C. Coleman.

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THE MYSORE AGRICULTURAL CALENDAR AND YEAR BOOK, 1954

CROP WEATHER CALENDARS

By S. P. VENKITESHWARAN, B.A. (HONS.)

Director of Agricultural Meteorology, Poona

It is a patent fact that the crops depend to a very great extent on the weather during their growing season. This is particularly so in a country like India which is aptly called the 'land of the monsoons' as it is mainly dependent on the monsoon for its water requirements for agriculture. Any abnormality in the monsoons would, therefore, very seriously affect the growth and the final yield of the crops.

From the time the crops are sown till the produce is harvested and stored they are entirely at the mercy of the weather, particularly so during certain critical periods. Every farmer knows that heavy rainfall immediately after sowing would wash away the seeds and the seedlings and depress considerably the germination percentage. On the other hand, a prolonged drought immediately after germination would result in the tender seedlings withering away and the entire crop may need resowing. During the vegetative phase the crops require well distributed rainfall, the wet spells alternating with periods of clear weather to facilitate intercultural operations and also to promote their healthy growth. Cloudy and muggy weather during the flowering and fertilising period would cause poor grain setting and so ruin a crop. Heavy rainfall or high winds during the later stages of the growth would cause lodging of a crop which till then was very promising. Again at the harvest and threshing times any rain would be untimely and may result in a serious loss to the cultivator.

It is, therefore, not surprising that the farmer should want to know when the rains are likely to set in, how the rainfall would vary from day to day during the season, when breaks in wet spells are expected and when the rains are likely to recommence and the occurrence of any other weather phenomena which would affect his crops. This information would help him to time the various important agricultural operations like preparation of the seed bed, manuring, sowing, transplanting, inter-culturing, harvesting, threshing, etc., with maximum economy and minimum risk to the crop. It was with the aim of supplying such information to the farmers in advance that the regional forecasting offices of the India Meteorological Department are preparing "Farmers' Weather Bulletins" and putting them on the air through the All India Radio Stations. The bulletins are issued daily in the local vernaculars and are included in the rural programmes of the broadcasting stations. Thus the "Farmers' Weather Bulletin" in Kannada for the Mysore State is broadcast daily by the Mysore Station of A. I. R. in their rural programmes. (Between 6-30 and 7 P.M.—*Ed.*)

To enable the weather forecaster to prepare and issue the "Farmers' Weather Bulletins" with as intimate a knowledge of the actual normal weather and warning requirements of the crops in the different seasons which vary with the crops and the locality, the Director of Agricultural Meteorology, Poona, has prepared a series of crop-wise and district-wise "Crop Weather Calendars" for some of the important "*Kharif*"[1] and "*Rabi*"[2] crops. Crop Weather Calendars for sugarcane also have been prepared. Albums of these

1. Kharif = Hot weather. 2. Cold weather.

calendars have been supplied to the regional forecasting offices for their guidance.

These Crop Weather Calendars have been based on the replies to a detailed questionnaire issud by the Director of Agricultural Meteorology, Poona, regarding the dates of preparatory tillage, dates of sowing, periods of germination, rapid vegetative growth and reproductive phase, dates of harvesting, normal weather requirements, limits of adverse weather like heavy or untimely rainfall, duration of wet and dry spells, high wind excessively high or low temperatures, hailstorms, etc., etc. in respect of each of the important crops in each of the districts in India. The information contained in the replies received was condensed and represented in a pictorial form in the Crop Weather Calendars. From such calendars the forecaster knows at a glance what the normal weather requirements of the various crops are and what warnings are to be issued to a particular district in a given weather situation during a particular phase of the crop.

By way of illustration a sample Crop Weather Calendar for rice is shown in Fig. 1. It will be noted that a Crop Weather Calendar consists of three parts. At the bottom is shown diagramatically the life history of the crop from the date of sowing to the date of threshing. The important 'phase' like sowing, germination, transplantation, tillering elongation, flowering, grain formation and harvest are also indicated. These 'Phases' cover certain time intervals indicated by horizontal arrows which depend upon variation (a) in crop variety, (b) in sowing date from place to place and year to year, (c) the nature of the crop itself. For ready reference the months and the standard weeks are also marked at the bottom of the diagram.

The middle of the calendar shows the normal weather requirements as far as the agriculturists have been able to state in their replies to the questionnaire mentioned earlier. The normal 'monthly rainfall' as well as the 'number of rainy days' are also indicated here.

The uppermost portion of the calendar indicates the nature of the weather warnings and the periods during which they are to be issued by the forecasting centre concerned.

Each Calendar has on the left hand top corner the 'index number of the district.' On the right hand top corner is given the 'Calendar number.' For example M. R. (K)-2 stands for Madras, rice (Kharif)-calendar number 2, the first letter standing for the regional forecasting centre and the second for the crop.

Crop Weather Calendars have been prepared in three volumes, for the following crops :—

Vol. I : Kharif or monsoon crops	Vol. II : Rabi or winter crops	Vol. III : Sugarcane crop
Rice, Cotton, Jowar (Sorghum), Jute.	Rice, Wheat, Cotton, Jowar (Sorghum), Pulses, Tobacco, Potato	The sugarcane crop which is sown in India in Feb.-March and harvested after 12-14 months.

Additions are being made to the above calendars and are also being revised in the light of later and additional information received. When this is completed and the calendars are finalised it will be possible to issue them for general use as they contain a wealth of information regarding the crops which is of equal interest to the agriculturist and the general public.

INDEX Nº OF DISTRICT :- 5202

CROP WEATHER CALENDAR

CALENDAR Nº M.R (K) - 2

PROVINCE : MADRAS
DISTRICT : Malabar.

CROP : RICE (Rain-fed)

WEATHER WARNINGS TO BE ISSUED FOR

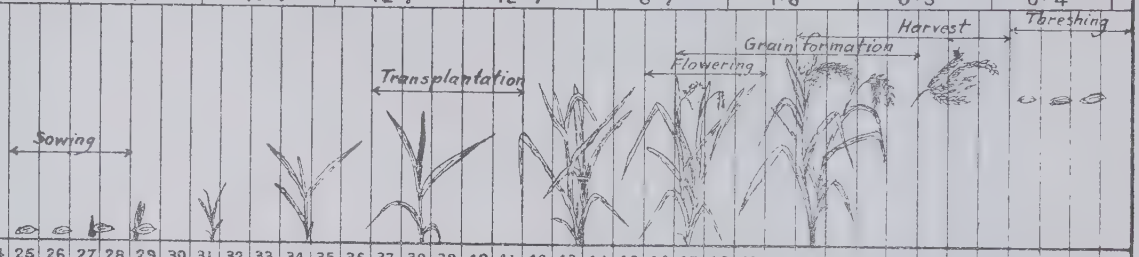
Rain	[Exceeding 3" per day	I > 2" per day I	Any rain
Duration of wet spell	[Exceeding 5 days	I > 2 days]	
Cloudy weather		[Cloudy weather]	
Droughts	[Exceeding 7 days]		
High winds			[Exceeding 20 m/p/h]
Temperature			
Hail storm			

NORMAL WEATHER REQUIREMENTS

[3 TO 4 GOOD SHOWERS EVERY MONTH I BRIGHT WEATHER]

MONTHLY RAINFALL	3·00	8·00	31·33	32·24	16·68	8·22	10·57	5·50	1·11	0·31	0·27
NUMBER OF RAINY DAYS	4·4	8·6	23·3	25·4	19·7	12·7	12·7	6·7	1·6	0·5	0·4

LIFE HISTORY AND MEAN DATES OF IMPORTANT EPOCHS OF CROP GROWTH.



STANDARD WEEKS	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	1	2	3	4	5	6	7	8	9
MONTHS	APRIL				MAY					JUNE								JULY					AUGUST				SEPTEMBER					OCTOBER					NOVEMBER					DECEMBER					JANUARY				FEBRUARY			

AGRI.MET. METEOROLOGICAL OFFICE, POONA

C.W.C. - 2

FIG. 1.

FIG. 2. A new garden planted with young seedlings

FIG. 4. Nayakanakere byle at nuvalli (Gardens thinned ou to Anabe roga disease).

FIG. 3. A young good bearing tree at Honnuvalli, Tiptur.

FIG. 5. Bamboo Pole ladder.

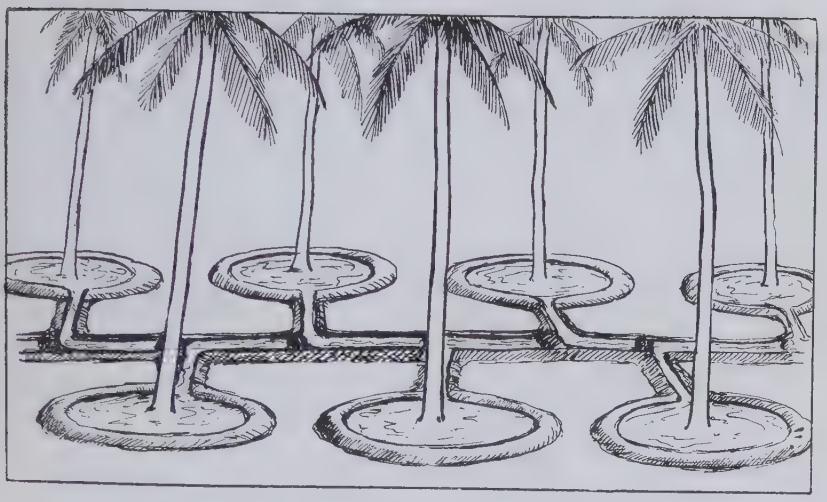


FIG. 6. Irrigation basins

COCONUT CULTIVATION IN MYSORE STATE

INDIAN CENTRAL COCONUT COMMITTEE,
ERNAKULAM

There is a general belief that coconut thrives only in the coastal areas and on islands. Coconut cultivation in Mysore proves that this is not correct. In Mysore coconut grows and yields well at places 300 miles inland and about 2,000 to 3,000 ft. above sea level. Recent statistics show that the area under coconut in the State is of the order of 1,85,000 acres. Mysore's *ball copra* has earned a deserved reputation for quality, colour and taste in the copra markets of India. The Agricultural Assistant in the office of the Indian Central Coconut Committee recently undertook a tour of the coconut growing areas of Mysore along with some officers of the State Department of Agriculture and his observations and experiences are set forth in this article.

The coconut areas of Mysore can be divided into three classes. 1. Dry areas, (2) Riparian areas, (3) Irrigated areas.

1. DRY AREAS

The bulk of coconut cultivation in Mysore is concentrated in the taluks of Tiptur, Chiknayakanahalli, Turuvekere, Arsikere and Banavar situated in the dry areas. The annual rainfall here is 20 to 25 inches only. A few rains fall both during the south-west and the north-east monsoons. But water is conserved by building dams across water courses and streams in the valleys. The area is dotted over with reservoirs of water which vary in size from half a sq. mile to one sq. mile. Coconut and paddy are cultivated near these reservoirs. On account of the nearness of the reservoirs the trees are not affected by drought. Only forty trees are planted in an acre of land in these dry areas. A tree per *guntha* (2½ cents) is the rule and the trees are planted in straight lines. The growers realise that if there are more than 40 trees per acre the available supply of soil moisture would be deflected soon and the trees affected by drought. The Mysore practice should serve to open the eyes of coconut growers in the Chirakkal taluk of Malabar district where there is overcrowding of trees. In the dry areas of this taluk coconut trees are seen planted only 20 ft. apart. The reason advanced is that the leaves of adjoining trees should touch so that the whole garden will be sheltered from the sun and the soil would not lose its moisture. They find it difficult to understand that soil moisture cannot be conserved in this manner and that it can be done only by regular seasonal cultivation of the soil.

As the coconut palms in the dry areas of Mysore are well spaced and planted in straight lines they get plenty of light and therefore grow up straight. They gain height only slowly. The crown of each palm resembles an unfurled umbrella. In some gardens of Turuvekere, one comes across trees which are more than 100 years old and 75 ft. in height; they still have thick-set crowns and yield well.

Because the trees are well-spaced their yield is high. The per acre yield in Mysore is higher than that in Kerala. Adequate spacing of the palms also makes it easy for inter-crops to be raised. There are many growers who raise crops of ragi, jowar, gram and coriander in their coconut gardens and get an income of Rs. 200—300 per acre. Those who own pump-sets grow tomatoes, cabbages, plantains, etc., and earn about Rs. 500 per acre The Mysore climate favours cultivation of vegetables like cabbage. Sri M. R. Rajappa of Maranagere grew cabbages last year in his 3-acre coconut garden and got

about Rs. 2,000 from the sale proceeds. Sri R. Sitaramayya of Acharyapalayam got about Rs. 300 per acre by growing coriander in his coconut garden.

Above all, wide spacing mitigates the rat nuisance. Rats cannot then jump from one tree to another and if the trees are given tin-plate girdles no rat would climb up them. If coconuts are properly spaced in the dry areas of Malabar, growers could successfully raise in their gardens inter-crops, such as paddy, gram, etc.

The soil in all the six districts of Mysore State toured by the Agricultural Assistant consists of disintegrated granite. Laterite rocks are found only in the *Ghat* districts of Shimoga and Chikmagalur. As coconuts are usually planted in valleys, the soil is found to be fertile. In Chiknayakanahalli the soil is a sandy loam. In most places loamy soil was come across. The soil in the riparian areas has a lot of silt carried by floods and is very fertile.

Seedlings and how they are planted

In Mysore they grow the ordinary tall variety of coconuts found in Kerala. A variety known as "Gangapani" was seen at Honavalli. This is said to be noted for its tender nuts. But these nuts do not appear to be sweeter than those grown elsewhere.

The whole of Mysore has only one Government Nursery. Until recently there was a nursery at Arsikere; now there is one at Hebbal near Bangalore. Seedlings supplied from the Government Nursery are seen planted in the Chamundivihar garden in Mysore city and in the Kasturba Trust's garden at Arsikere. They are growing up more vigorously than seedlings obtained from elsewhere.

Coconut growers commit mistakes in the selection of seednuts and seedlings. They collect them from palms standing in irrigated gardens. They do not reject seedlings which are not healthy and vigorous. Sri K. V. Murulappa of Kengere village near Huliyar had planted in his garden both quality seedlings as well as those of doubtful worth. They have now grown into the yielding stage and the difference in favour of the former is obvious.

Mysore growers usually plant 3-year old seedlings. Although the water-table is very low deep-planting is not generally practised. This results in part of the bole area being left exposed above the soil surface Only a little ash is applied at the time of planting. The seedlings are protected from cattle by fencing them round with the leaves of a kind of date palm.

Three-year seedlings are planted so that they may grow up without much care being bestowed on them. But one-year old seedlings from the Government nursery planted along with the 3-year olds of private origin, in the Chamundivihar and Kasturba Trust Gardens, are seen to have outstripped the latter in growth. Government nursery seedlings have earned a reputation everywhere. The demand for them is naturally far in excess of the supply.

In dry areas where the water table is low, seedlings should be planted deep. When they grown up their boles would then be well below the soil surface. Such trees will have plenty of roots, firm anchorage in the soil and long life. Trees which are surface-planted will not have a sufficient number of functioning roots by the time they attain middle age. They will then begin to deteriorate. If coconut palms are to live long and yield well they should be planted deep enough and with sufficient space between palms.

Quality coconut seedlings are obtained as a result of a rigorous selection of the area in which coconut gardens stand, of the gardens themselves of the palms suitable to be parent palms, of the seednuts collected from them and of the seedlings in the nursery. Gardens in dry areas are to be preferred to others. Riparian areas such as, Malur, Chikmagalur, Kudalur, Chandakvadi and Hebsur and irrigated areas like Mandya, Babbur and Adivala are not suitable for seednut selection. Coconut palms here yield well not because of their intrinsic worth only but because of irrigation and soil fertility also. Seednuts from parent palms standing in the dry area will give seedlings which will thrive anywhere.

The garden selected for the location of parent palms should consist of middle-aged trees which are good bearers. Those selected as mother palms should be healthy and vigorous, have thick-set crowns, and be good bearers. They should be regular in bearing, yielding heavy crops every year instead of in alternate years. Trees producing barren nuts or trees that shed their nuts before the nuts attain full maturity should not be selected as mother palms.

Seednuts should be of medium size with thin husk, thick kernel and big eyes. Nuts harvested during the months of January-February to April-May are the best for seed purposes. When they are fully mature they should be plucked, lowered to the ground with the aid of ropes and preserved in a shed or in some high place. When the husk is dry and the water inside has dried up a little, they can be sown in prepared nursery beds by about the commencement of the south-west monsoon. Nine months after germination the seedlings should be selected. Those which do not have good girth at collar and those which are weak and stunted in growth should be rejected and destroyed.

Pits for planting seedlings should be dug soon after the north-east monsoon rains. They should be about 4 feet square and 3 feet deep. When digging pits, the top soil should be kept separately and the remaining earth used to put up bunds all round the pit head. Such bunding prevents rain water from flowing into the pit. Rubbish should be burnt inside the pits two or three times. All unburnt or half-burnt things should be removed from the pits and thrown away. If allowed to remain in the pit, white-ants may be attracted to it.

After the pit has been dug and treated as mentioned above, put into it the top soil that has been kept separately. Add to this some charred earth by trimming the sides of the pit and some sand. Mix the whole well and heap them into a 1-foot mound in the centre of the pit bottom. Plant the seedlings on this mound with the commencement of the south-west monsoon. When planting put round the seednuts a mixture of $\frac{1}{4}$ lb. of Gammexane and 5 lbs. of ash. The Gammexane will prevent white-ant attack. Rain water that directly falls into the pit will remain all round the central mound and will not affect the seedling planted in it. After the seedling has established itself well and put forth 2 or 3 leaves sprinkle $\frac{1}{4}$ lb. of ammonium sulphate all round the mound when there is rain. It dissolves in the water and becomes good manure for the seedling and hastens its growth.

If possible the seedling may be watered for one or two years during the summer months. In case the seedling is watered, a quarter pound of ammonium sulphate may again be applied to the seedling. The dosage can be increased with the growth of the seedling. At the beginning of the monsoon put into the pit 5 to 10 lbs. of ash and about a month after, the ammonium sulphate. If the seedlings are manured as mentioned above they will register good growth and health.

Cultivation and Manuring

It is usual to plough coconut gardens in the dry regions, seven or eight times a year. Many plough twice or thrice at the commencement of the south-west monsoon to raise inter-crops, such as coriander, chillies or ragi. Again in September-October the garden is ploughed twice and once more in November-December two or three times.

During the summer of alternate years or once in 3 years sheep are penned in the gardens. In the years this is not done soil from adjoining forests or silt from nearby tanks is brought and spread in the garden.

Ash is not usually used as a manure in these areas. Twenty-five pounds of good ash contain 1 lb. of potash, ½ lb. phosphoric acid, and a little of all other nutrient elements except Nitrogen. Ash is, therefore, a good manure. If kitchen ash is stored in a shed, it can be used as manure. If 50 to 60 tins of ash per acre are applied to the garden when raising intercrops, it will do good both to the intercrops and to the coconuts. In Mysore one comes across lantana bushes everywhere. Its ash is of very good quality and plenty of it could be easily made available.

Green manure crops are seldom raised in the Mysore coconut gardens. As a result of departmental propaganda a few people are seen to grow gram in their gardens and incorporate it into the soil. But ash is not applied to the garden when the gram is sown. The gram crop does not, therefore, come up well. Green manure crops such as *Kolinji*, Sunn-hemp or wild Sunn-hemp (*Crotolaria striata*) are not found raised.

What is primarily required in the dry coconut areas of Mysore is the burial of husks. Trenches 5 ft. wide and 2 ft. deep should be dug between lines of coconut palms and husks should be packed in them to a height of 1¼ ft. with the fibrous side up. The trenches should then be covered up. The husks absorb water during the south-west and north-east monsoons, and the coconut palms are thus assured of a good supply of moisture. The husks also contain small quantitles of potash and phosphoric acid useful for the palms. Husks which are to be used for burying in coconut gardens should be kept in a shed without being exposed to rain. If left exposed they may lose the manurial elements contained in them.

If husks are buried once, for at least a period of five years following, the garden may not require watering or manuring. If trenches for burying husks are dug lengthwise in June 1954, they may be dug breadthwise for the purpose in June 1959. As there would be plenty of moisture, manure and aeration in the trenches the roots of the coconut palm that penetrate into them grow and function very effectively. In Mysore husk-burial as described above should be very cheap indeed as the cost of husks is quite cheap and is only Rs. 4 per thousand.

Collect and properly store cattle manure and ash, make plenty of compost out of all available rubbish, bury husks, grow in the garden and plough in a green manure crop, use occasionally some fertilizers—these are the things to be done as far as manuring goes. In many places the palms were seen to have pale leaves, on account of inadequate manuring. Such trees should be treated with any one of the manure combinations given below, at the beginning of the south-west monsoon :—

I		lbs.
Ammonium Sulphate	...	3
Potassium Sulphate or Muriate of Potash	...	2
Superphosphate or bone meal ...	...	2

			lbs.
II			
Oil cake of any kind	...	...	15
Bone meal or Superphosphate	...	...	2
Ash ...	...	...	25
III			
Press mud (from Jaggery boiling)	...	...	50
Pupae of the silk worm	...	...	25

Press mud could be had from the Sugar Factory at Mandya and the pupae of silk worms from the Spun Silk Factory at Chennapatna. The manures should be applied in broad basins dug round the palms in June and should be covered up immediately with a layer of earth.

Harvesting

Coconuts in Mysore are harvested with a sickle tied to the end of a bamboo pole. Harvesting is done eight times a year. Nuts of uniform size are stored in lofts for about 10 months and the ball copra is sold. Tiptur, Arsikere and Banavar are well known copra markets.

The nuts are harvested in the manner described above in order to avoid undoing and tying again the palm-leaves tied round the tree at a certain height, apparently to prevent pilferage of nuts. But if a bamboo pole with steps at the joints is used, the tree could be easily climbed, the crown cleaned, beetles extracted and beetle holes filled with a mixture of sand and B. H. C. The illustration (Fig. 6) alongside will show how the bamboo pole ladder is used for climbing coconut palms.

Water-logging and drainage

Even in the dry areas there is water-logging in some gardens, during the rainy season. This results in the yellowing of leaves and reduced yield. Catch drains should be dug in such gardens and the excess water drained off.

Water-logging is bad for coconut garden. Sri Suryanarayanappa of Turuvekere has a coconut garden at Mallaghatta. It suffered from water-logging on one side but when the level of the adjoining plot was lowered for paddy cultivation the water in his garden was easily drained off and the trees are doing very well now.

Pests and diseases

Anabe Roga.—Is rampant at Honavalli and Hosapatnam. In the place called Nayakara Kiseli the disease has nearly destroyed all the palms in the locality. It is understood that the Mysore Department of Agriculture is undertaking certain investigations regarding this disease.[1]

The rhinoceros beetle is the most important pest come across. Nothing is heard mentioned about pests like *Nephantis serinopa* and the red palm weevil. The rhinoceros beetle can be controlled by extracting from the crown of the trees the beetles with the aid of a beetle hook and filling the holes with a mixture of B.H C. and sand. To destroy the beetle grubs in manure pits spray them with B.H.C. suspended in water (1 oz. of B.H.C. with 12 gallons ot water).

The beetle hook is an iron rod about $2\frac{1}{2}$ ft. long with a hooked end. The hook is inserted into the beetle hole and the insect drawn out.

1. A Circular has since been issued by the Department.—*Ed.*

2. RIPARIAN AREAS

There are thriving coconut gardens on either banks of the river Kanwa near Channapatna and the river Suvarnavathi near Chamarajanagar. Every year these rivers rise and overflow their banks and deposit silt in the coconut gardens. The gardens on either side of the Suvarnavati are extremely fertile and mixed crops of coconuts, arecanuts and plantains are cultivated in them. In order that the silt may not be washed off by the receding floods the gardens are converted into a number of channels and bunds. Plantains are grown on the bunds. There are seven or eight floods a year and they fill the channels with silt. When the silt begins to dry up it is shovelled on to the bunds.

In these areas about 45 to 50 coconut palms are planted per acre. In addition to those, there will be in the same acre about 200 areca palms and the same number of plantains. In the gardens on the banks of the Kanwa, only coconut trees are come across. The quantity of silt deposited in them is comparatively less.

Sri K. Venkatachalayya of Hebsur on the bank of the Suvarnavati furnished the following figures of income and expenditure in respect of an acre of his garden :—

Expenditure

		Rs.	A.	P.
Intercultivation in September and November including shovelling of silt to the bunds	...	100	0	0

Receipts

Income from 45 coconut palms bearing on an average 50 nuts each at Rs. 150 per 1,000 nuts.	...	337	8	0
Income from 200 areca palms at Re. 1 per palm	...	200	0	0
Income from 200 plantains at Annas 8 each	...	100	0	0
Total income	...	637	8	0
Net receipts	...	537	8	0

Areca thrives very well here. Bunches with about 1,000 nuts could be come across. The plantain bunches also did not look inferior. But a mixed crop of coconut, arecanut and plantains makes the garden too crowded.

It would be better to cultivate the areca palms separately. No manuring is required in these places. They are really blessed by nature.

3. IRRIGATED AREAS

Innumerable coconut gardens have been started in places like Babbur, Adivala and Mandya where facilities for irrigation have become available. In the Government farms at Babbur and Mandya the palms have already begun to yield.

The Babbur Government Farm is situated about 3 miles from Hiriyur. There are in this farm a yielding coconut garden, a coconut nursery and a few newly planted seedlings. The bearing palms are reported to be of the order of 1,200. As an irrigation canal passes through the farm there is no dearth of water for the palms.

Irrigation is done by letting water into the garden as a whole once in a month during the summer season. The result is that the soil gets caked up and weeds flourish. The more advantageous procedure will be to dig basins

round the palms and let water into them through irrigation channels. The garden should be ploughed twice or thrice at the end of the north-east monsoon and then the basins and channels prepared. As the Babbur area is noted for paddy cultivation plenty of paddy stalks were spread out in the basins and water let into them once a week.

Manuring

At the commencement of the south-west monsoon apply broadcast in the garden, ash at the rate of 60 tins per acre and plough it in. Sow the seeds of some green manure crop. If green manure seeds are not available sow cow-pea or horse gram. When the crop begins to flower, slash it down and incorporate it into the soil.

When watering commences add to the basin round each palm 3 lbs. of ammonium sulphate, 2 lbs. of muriate of potash and 2 lbs. of superphosphate fork them in, cover them with paddy straw stalks and let in the water.

There are some good middle-aged palms in Babbur farm. Seed nuts for the nursery are collected from these palms. It is undesirable to collect seednuts from irrigated gardens. It is therefore, best that seednuts for the nursery are collected from the dry areas.

Some palms in the farm have been planted on narrow bunds in paddy fields. Their roots do not have sufficient soil to spread out. Earth should be added round them for a radius of 4 feet. The roots could then spread out properly and the tree grow up well. At present the roots reach down to the fields and rot from the effects of water-logging. In due course the heaps of earth added round the base of individual palms may be connected up by filling up the interspaces to form one long bund about 12 feet wide.

New method of planting

If seedlings are planted in straight lines leaving a distance of 42 ft. between lines and 24 ft. between seedlings, some 43 seedlings could be planted to an acre. If this method of planting is adopted, it would be easy to raise inter-crops in coconut gardens. A person owning 5 acres of coconut garden will then have about 3 acres for raising inter-crops. Paddy, ragi, horsegram, plantains, vegetable, etc., could be freely grown in the interspaces. As the rows of trees are wide apart the palms get plenty of light and yield well. This method has been recommended to the Babbur Farm management.

Visvesvaraya Canal Farm, Mandya

This is a sugarcane farm of about 600 acres. There is in it a plot having about 200 coconut palms which have begun to bear. It is neither cultivated nor manured. There are some uneconomic trees and shrubs also in this plot. It is water-logged during the rainy season. For the above reason the coconut palms are in a weak condition and do not bear well.

If the canal that runs near this plot is deepened water-logging during the rainy season can be avoided. One or two catch drains also should be dug through the garden. All the economic trees and shrubs in the garden should be cut and removed and the garden itself cleared well.

At the commencement of the south-west monsoon the garden should be ploughed twice or thrice and ash at the rate of 60 tins per acre applied to it broadcast. The seeds of some green manure should then be sown in it and when the green manure crop begins to flower it should be cut down and ploughed into the soil. At the close of the north-east monsoon the garden

should be ploughed again. As the irrigation canal runs near this garden, it should be easy to let in water through channels into basins dug round the palms. No great harm will be done even if the trees are not watered as the water table here is not very low. If the trees are watered it will be advantageous to fork into the basins round each palm the following manures:—

	lbs.
Ammonium sulphate	... 3
Superphosphate	... 2
Muriate of potash	... 2

It would be enough if the watering is done once a week. To prevent the water from evaporating too fast, crushed sugarcane refuse may be spread in the basin.

Possibili ies of expanding Coconut Cultivation in Mysore

There are many valleys in Mysore in which coconut could be cultivated. At present a variety of date palm is found growing in them. These palms are used for tapping purposes. In areas where prohibition has been introduced in Mysore these palms have, however, become useless. They could, therefore, be cut off and coconuts grown instead.

The valleys mentioned above lie mostly in the dry area and the soil in several of them seems to be alkaline. In the rainy season there is some water-logging also in them. Before planting coconut in such places drainage canals should be dug in them. If, after planting the seedlings the soil is properly manured and cultivated the alkalinity will gradually disappear. After this, intercrops can successfully be raised in the gardens.

The Government and the people of Mysore appear equally eager to expand coconut cultivation in the State. After establishing the Vanivilas and Krishnaraja Sagar reservoirs the Government have been encouraging people to start coconut gardens in the areas served by them. In the Vanivilas Sagar area about 3000 acres are said to have been brought under coconut.

The supply of quality seedlings and persistent propaganda among cultivators appear called for. One or two more nurseries seem necessary if seedlings are to be distributed in sufficient numbers.

BROAD HINTS ON ARECANUT CULTIVATION

INDIAN CENTRAL ARECANUT COMMITTEE, CALICUT

The chewing of betelnut is a habit which has become inseparable from our way of life and has therefore, come to stay. It is perhaps the most popular and, at the same time, an innocent luxury for the millions of poor people in this country. Arecanut, unlike other commercial crops, occupies a peculiar position in that the cultivation of this crop is centered in the hands of poor agriculturists with small holdings which, on an average, do not exceed one acre in area. This crop has, in the past, received little attention in the matter of scientific investigations.[1] The production in our country is today inadequate to meet the demands of the consuming public. We have therefore, to depend upon foreign countries to supply the gap. On an average, we import between 30 to 40 million rupees worth of arecanuts every year. It is, therefore, important that we must step up our production in order to make ourselves self-sufficient and save this annual drain of foreign exchange. On

1. Some work has been done in the Mysore Department of Agriculture and 2 bulletins were issued.—*Ed.*

account of the protection which has been given to the local industry by the imposition of a duty of 9½ annas per pound and of a monetary ceiling on the import of arecanuts, there were better prices for the local nuts. This enabled the growers to pay a little more attention to their crops.

The important consideration, therefore, is to adopt improved methods of cultivation to augment the yield. Considerable diversity exists in agricultural practices in different parts of the arecanut producing areas. The cultivation practices in certain regions are primitive affording considerable scope for improvement. The following gives a general idea as to how an arecanut garden could be started and maintained.

Soil

Arecanut is a delicate tropical palm thriving well in regions of heavy rainfall and high humidity. Its cultivation is mostly confined to the heavy rainfall areas of Malabar, South Kanara, North Kanara, Mysore, Coorg, Bengal and Assam. It could be grown in other regions also, provided the soil is of a suitable type with proper irrigation facilities. Banks of rivers, valleys between hills, hill slopes and homesteads may be selected for starting an arecanut plantation. Though arecanut is found to grow in a variety of soils, adaptability to these diverse conditions should not mean that any kind of soil can be taken up for its cultivation. The primary need is that the soil should be capable of thorough drainage and be retentive of moisture that is required by the crop Stiff clays, though inherently rich, is generally unsuitable as it tends to water-logging. Laterite and laterite loams answer the purpose very well.

Preparatory Cultivation

The site earmarked for arecanut plantation has, first of all, to be levelled up and, if of an undulating nature, it should be terraced and levelled. Arecanut seedling, in their early stages of growth, require sufficient protection from the severe heat of the sun. Therefore the garden should first be planted with plantains and when they have established satisfactorily, arecanut seedlings should be planted close to the plantains so that the tender seedlings will be protected from the severe heat of the sun.

Seeds and Sowing

Propagation is from the seeds which may be sown directly in the garden *in situ* or by raising seedlings and transplanting them after they have grown in the nursery for periods ranging from 1 to 3 years. Transplantation of seedlings appears to be generally good and widely adopted in most parts of the country except in Travancore-Cochin where sowing the seed directly in the garden is also adopted. Reliable seed material is the basis of good agriculture and it is doubly so in the case of a perennial crop like arecanut.

Mature seeds that are specially selected for seed purposes should be dried in shade for a few days. Drying under the direct heat of the sun is not considered good. The seeds are then sown directly in well prepared seed beds in an arecanut garden itself or elsewhere under proper shade. Seednuts are also sometimes sprouted before sowing in the nursery beds. The latter method ensures elimination of non-viable seeds. They are planted about 4"—9" apart, shaded properly and irrigated frequently. Seednuts are generally harvested during January-February and the season for sowing commences immediately thereafter in February-March. The period for which seedlings are to be left in the nursery vary from one year to 3 years, according to the local practices which in turn depend upon the nature of the soil, situation of

the land etc. When the seedlings have grown well, it should be possible to eliminate poor and unhealthy seedlings. Robust and healthy seedlings alone may be utilised for transplanting in the main garden.

Transplantation

Plots intended for transplanting areca seedlings should be previously prepared and planted with plantains spaced about 8′×8′ or 8′×10′. After the plantains have grown well to provide shade, areca seedlings are planted in previously prepared pits of about 1½' cube close to the plantains. Young seedlings are planted rather shallow while old seedlings are planted fairly deep. Transplanting is usually done in the rainy months from July to September.

Manurial Regimen

In order to get adequate returns from the crop it is essential that the crop should be judiciously manured. Though no scientific data are available regarding the manurial requirements of arecanut crop or the quantity of different manurial ingredients required for arecanut plantation, experience has show that green leaves, wood ash and cattle manure are generally responded to well by the crop. The practice of manuring arecanut garden is prevalent only in some places whereas in many other places no manure is applied. Some tracts like Mettupalayam and river bank plantations in Travancore-Cochin, Assam, Bengal, etc. are inherently fertile since they receive a good lot of transported silt when rivers get flooded during the monsoon months.

How much to apply and what to apply depend upon the financial resources of the cultivator and availability of manures. Application of organic manures like groundnut cake has shown good results. In places where green leaves are scarce, it is possible to grow green manure crops in the garden itself so that they could be incorporated after proper growth. *Crotolaia striata*, wild indigo, sunhemp, etc. are some of the green manure crops that could be grown in arecanut gardens. It will also be advisable to grow *Glyricidia maculata* all round the arecanut garden which would supply periodically enough of green matter besides protecting the border plants of arecanut seedlings from heat. By systematic application of green leaf and other manures, great possibilities exist to increase the yield of arecanut palms.

Intercultivation

Diverse cultural practices exist in different parts of the country. Intercultivation of arecanut garden is seldom done in Assam, parts of Malabar, Bengal and Travancore. It is believed by some that digging an arecanut garden does more harm than good, by injuring the roots. But in Mysore, South Kanara, North Kanara and parts of Malabar, gardens are regularly cleared of weeds and hoed on the wake of the South-west Monsoon. A second hoeing is also resorted to towards the end of the North-east Monsoon. However hoeing has to be done a little removed from the base of the palm say about 1½ to 2 feet away. Experienced growers claim that efficient intercultivation increases the yield by 10—20%. Periodical cleaning of irrigation channels, re-alignment of drainage system, transporting of good earth from outside, marking and eliminating irregular bearers with a view to substitute regular bearing palms and screening young palms from sun scorch in summer are some of the regular intercultural operations that have to be done in an arecanut garden.

CULTIVATION IN TWO DIFFERENT VILLAGES IS LIKE MARRYING TWO WIVES.

Irrigation and drainage

Arecanut is grown both under irrigated and rainfed conditions. Where sub-soil moisture is high and the rainfall is well distributed, no irrigation may be necessary. But such conditions are rarely seen during summer months. Irrigation during hot months seems to be necessary. In Bengal, Assam, North Malabar and some parts of South Malabar and Travancore arecanut is treated purely as a rainfed crop. In parts of South Malabar and Cochin, water is lifted from shallow wells and irrigated for about 5 months in summer (*i.e.* from December to May). Irrigation from perennial tanks or spring channels situated at the head of the garden, by gravitation flow, is the common practice in South and North Kanara and Mysore. In these areas irrigation charges are very low while in the well or tank-irrigated areas the charges are high going up to about Rs. 400 per acre. The frequency of irrigation depends upon availability of water, nature of soil and the means of the grower. Generally it ranges from 1 to 2 weeks between each successive irrigation.

Drainage of sub-soil water during the high rainfall months of June to August in the west coast is as important as irrigation during summer months. Mere drainage of surface water is considered to be enough by many growers. The soil gets water sick during the monsoon months and in order to drain off excessive sub-soil water, drainage channels have to be dug in between rows of palms. If sub-soil drainage is not perfect, the trees manifest symptoms of several diseases.[1] The evil effects of drainage are manifest in many arecanut gardens in heavy rainfall areas.

Underplanting

The life of an arecanut garden is supposed to be about 60 years though palms in the garden may be dying off and on. It will, therefore, be necessary to replace dead ones and plants that turn uneconomical. Underplanting is therefore done early in the life of the crop in Mysore, Malabar, and Cochin and late in South Kanara and underplanting therefore commences only when most of the first planted palms become uneconomical usually after about 30 years of growth. In other areas there is no systematic effort to underplant with young seedlings.

Intercropping

Except in some parts of South Kanara and Mettupalayam, some subsidiary crop or other is raised in every areca garden. In Malabar, Travancore-Cochin, Assam and Bengal arecanut palms are grown along with coconut palm, mango, jack, plantain, pepper, betel or cardamom. In Mysore, South Kanara and North Kanara, plantain, pepper, betel and cardamom are generally grown mixed with arecanut. This does not appear to be harmful to the areca palm as the smaller plants are properly manured and they also leave a residuary effect to the advantage of the areca palm. Growing betel and pepper vines may be an economic proposition provided the crops are well manured and cared for.

Pests and Diseases

Areca palm is generally free from the depradation of any serious insect pest. But monkeys, rats and squirrels and birds in some places damage arecanuts to a considerable extent. Protection from wild animals is essential in the early stages of a plantation in hilly or jungle clad localities. The

1. Like Anabe Roga (*Ganoderma lucida*).—*Ed*

most common and serious fungus disease is the periodically occurring 'Mahali' or 'Koleroga' caused by *Phytophthora areca* prevalent in an epidemic form in the heavy rainfall regions of Mysore, North Kanara, South Kanara, Malabar and Travancore-Cochin. The fruits of a season's labour and investment are brought down in no time and the prevention and control of this disease by a pre-monsoon and a post-monsoon spraying with 1% plain Bordeaux Mixture is one of the most essential of arecanut farm operations. Paucity of labour, heavy and intermittent rainfall and the enormous cost, may be impediments and yet it is very systematically adopted throughout the vulnerable areas of the South Indian areca tract. The other diseases are of a purely localised nature and are not so very important, nor have remedies or preventive measures been evolved.[2]

Harvest

Certain arecanut regions such as Malabar, Travancore-Cochin, Mysore and Coimbatore harvest tender nuts for the preparation of 'kalipak', from June to December, while in other places such as South Kanara, North Kanara, parts of Coorg, North Malabar and Mysore and parts of Travancore-Cochin, ripe nuts are harvested from October to March, dried and prepared into 'chali' or 'supari'. In Bengal and Assam, ripe nuts are harvested for immediate use without any curing. In most of the regions, harvested nuts are generally let down as such, allowing them to be scattered. But in parts of Mysore, South Kanara and Malabar and Cochin, the bunches are lowered down by means of ropes thereby preventing the tender nuts from shattering and getting damaged on account of the impact. When closely planted, the man who climbs the trees passes on from the top of one tree to another and to as many neighbouring ones as possible finally getting down after the entire harvest is completed.

Yield

Yield of arecanuts is dependent upon several factors. The number of trees per acre is the largest variable factor governing the acre—yield of arecanut. It will also depend upon how the produce is gathered—whether harvested in tender stages and processed into 'kalipak' or harvested when the nuts are mature and sundried. Even the tender stage, the yield will depend upon the stage of maturity of the tender nuts. Irrigated crop always give a higher yield than purely rainfed crop. The average yield of tender processed arecanuts will range from 600 to 800 lbs. per acre while the yield of mature sundried arecanuts will be about 1,500 lbs. per acre.

Preparation for the Market

People of the west coast of South India, West Bengal and Assam, chew fully ripe nuts in the harvest season and pit or water cured nuts during the off season. In Telugu, Tamil and Kannada speaking areas of South India, tender processed nuts known as 'kalipak' are chewed. In other parts of India, *viz.*, central and upper India, people use only mature sundried 'supari.' In South Kanara, North Kanara, parts of Mysore, North Malabar, Travancore and Coorg, the ripe nuts are sundried for a number of days and subsequently husked, bagged in gunnies weighing 1 cwt. and marketed. In Mysore, South Malabar, Travancore-Cochin and Coimbatore, tender nuts are

2. Remedy for anabe roga has been evolved by the Mysore Department of Agriculture—*Ed*,

sliced according to the market requirements, boiled and coloured with the 'kali' or 'chogaru' to give a glossy appearance and dried. It is a skilled cottage industry. In Malabar and Travancore-Cochin, it is generally in the hands of professional curers who may also happen to be traders, but in Mysore, North Kanara, etc., the growers themselves do this operation. There are many grades of processed tender nuts and sundried whole nuts recognised in trade. The growers seldom grade their produce before marketing, but still they separate the produce into inferior and superior class. It will be profitable for the growers to grade the produce according to the specifications obtaining in the market.

BIDI TOBACCO

DR. B. S. KADAM[1] AND T. KRISHNAMURTY[2]
Central Tobacco Research Institute, Rajahmundry.

The annual area under bidi tobacco is estimated about 2,10,000 acres representing very nearly a fourth of the total acreage under tobacco in the country. Kaira and Baroda districts of north Gujerat in Bombay account for 1,00,000 acres and the districts of Kolhapur and Belgaum, in southern Maharashtra, also command an equal area. These two tracts are known as "Charotar" and "Nipani" respectively. The remaining 10,000 acres are scattered in other States.

Varieties

Keliu is the most predominant variety in Charotar and an improved strain K. 49, is in general circulation because of its higher yield, uniform maturity and better quality. Surti is the predominant variety in Nipani. From this variety also an improved strain, S. 20, is now recommended as it has better quality and gives 10 to 12 per cent higher yield.

Preparatory cultivation

In Nipani it commences with a deep ploughing in May to throw the field into clods. The clods are broken by harrowing after the first showers. In Charotar, cultivation commences only after the first showers. The remaining operations in both the areas are almost identical involving 4 to 6 ploughings with a country plough and harrowings with a blade harrow, whenever necessary.

Manuring

Only 5 tons of farmyard manure per acre is applied in the Nipani area after breaking the clods. In Charotar the rate is from 5 to 15 tons and is applied before the first ploughing. Growers, who can afford, apply also 400 to 800 lbs. of oil cake two weeks before transplanting. Recent work at Nipani has indicated the usefulness of applying 100 lbs. sulphate of ammonia per acre (20 lbs. N) immediately before transplanting. In Charotar, it has been found that bidi tobacco will respond profitably to doses even higher than 120 lbs. N per acre in the form of oilcake i.e., about 1,700 lbs. of groundnut cake. Oilcakes were better than farm-yard manure but for the residual effect of the latter. Stemdust, a waste product of bidi tobacco processing factories, may be found to be useful at the rate of 3,000 lbs. per acre,

1. Director, Tobacco Research. 2. Agronomist.

Rotation

In the Charotar area, continuous tobacco without any rotation, is considered essential for production of quality tobacco. Cultivators with larger holdings always set apart a definite area for tobacco. In smaller holdings, the main rotation is tobacco-bajra-tobacco and to a lesser extent tobacco-kodra[1] tur mixture-tobacco. At Nipani, the practice of growing tobacco continously is not extensive and the main rotation is tobacco-jowar-tur mixture or gram-tobacco. Where irrigation facilities are available, sugarcane is intermediate crop. Bidi tobacco is however unirrigated in both the areas. The practice of green manuring with sunn-hemp or blackgram is practised on a small scale in Nipani.

Nursery

Application of large quantities of farmyard manure, 200 cartloads per acre or even more, is an important feature of raising nursery in the Nipani area. Sowings are done in both areas in the first week of July. Seed rates are always excessive, being 10 to 20 lbs. per acre of nursery. "*Damping off*" occurs when rainy or cloudy weather prevails continuously for a week or so. The same beds are resown a second or even a third time if the stand is unsatisfactory. The use of ammonium sulphate for forcing growth of seedlings is prevalent to a limited extent. Seedlings are ready for transplanting by the end of August.

Transplanting

Commences in the third week of August in Nipani and a week later in Charotar. The plants are spaced $3\frac{1}{2} \times 3\frac{1}{2}$ ft. in Nipani area and $2\frac{1}{2} \times 2\frac{1}{2}$ ft. in Gujerat. The seedlings are established by hand watering at Nipani but in Charotar, transplanting takes place during rains. No hand watering is necessary except in very unfavourable seasons. Experimental work has shown that, in Nipani, the spacing can be reduced to $3\frac{1}{2} \times 2\frac{1}{2}$ ft. without impairing quality whereas in Charotar it is found that by increasing the spacing to $3 \times 2\frac{1}{2}$ ft. or even 3×3 ft. better quality can be obtained without appreciable sacrifice of yield. Earlier transplanting by the end of July is recommended in Nipani if seasonal conditions permit.

Post-transplanting operations

Consist of 3 to 4 intercultures with bullock-drawn blade harrow and 2 or 3 hand weedings. In Charotar the crop is slightly earthed up by working a heavy blade harrow after the last interculture.

Topping and suckering

The crop is ready for topping six to eight weeks after transplanting when about 50 per cent of the plants are topped. Two further toppings at weekly intervals are required to complete the operation in all plants. At Nipani 10 to 12 leaves are maintained after removing all the bottom leaves up to 5 or 6 inches of the stem. In Charotar bottom leaves are not removed and the number of leaves maintained may be about 18 including 3 or 4 sand leaves. Recent investigations in Charotar have shown that maintaining 11 leaves, excluding 3 or 4 sand leaves, should be the best practice, when judged by both yield and quality. Suckers are removed 6 to 7 times at intervals of 10 days in Nipani whereas in the Gujerat zone a dozen or more suckerings are required in view of the higher level of manuring.

1. Kodra or Haraka, *Paspalum scrobiculatum*.

Harvest and Curing

Bidi tobacco gets ready for first harvest (when nearly 50 per cent of the plants can be cut) in the second fortnight of January, *i.e.*, about 4½ months after transplanting. A month before harvest, spangles or reddish brown spots begin to appear on the leaf and their number and size increase as the crop matures. The colour of the leaves also starts turning from dark green to greenish yellow. A plant is considered ready for harvest when the spangles have been formed in a majority of leaves and when they start turning greenish yellow. There are usually three harvests at intervals of a fortnight and the crop gets completely harvested by the middle of February. Sand leaves are first removed and dried in the sun and stored. These form the first portion of the produce. The whole plant is then cut and left upside down to dry on the spot. Curing in bidi tobacco is merely sundrying. In Charotar, the lamina is dry on the 3rd or 4th day whereas in Nipani it takes 5 to 7 days as the plants are arranged close to each other for drying. After drying the plants are removed to a threshing floor or verandah and the leafy portion from the midribs is stripped off by hand. Large leaf pieces are known as *bhuka* in Charotar and *motiphul* in Nipani. These form the main portion of the produce. Small portion of secondary veins and lamina still remain adhered to midribs. Midribs are severed from the stalk and allowed to dry for a day or two and portions of veins and lamina are then easily stripped off. This third portion of the harvest is called "*gheran*". Midribs are further dried in the sun for two or three weeks and form the fourth portion of the produce. All the four portions are kept separately on the floor in a godown or a roofed verandah. The heap of lamina is disturbed and remade a fortnight later so as to allow even drying.

Quality bidi tobacco is based on colour and thickness of leaf, extent of spangling and smoking quality. A bright greenish yellow colour called *popatia* in Charotar is considered good. Nipani product is usually more yellowish. The thickness of leaf pieces and extent of spangling indicate adequate manuring and good field culture. In smoking tests strength of smoke is perhaps the main criterion but testers claim to distinguish smoothness and harshness and to find out whether a particular sample will retain its strength for a long time or not.

For obvious reasons there is no grading of bidi tobacco as in cigarette and other types of tobacco. Recent experimental work in Charotar however has shown there is a quality gradient—higher the position of leaf better the quality. While stripping the leaves from midribs grading can be done simultaneously by keeping the produce from the lower and the upper half of plant separately.

Preparation for market

In Charotar there is no further operation for the grower except to dispose of the produce. In Nipani, however, stripped lamina or *motiphul* is broken up into small pieces of about ½" × ½" and sieved to eliminate thick lateral veins. These ½" pieces, called *jarda*, are the final product so far as the grower is concerned. The sale of *jarda* forms the main transaction between the grower and the buyer at Nipani. The other portions of harvest are sold separately later on. In Charotar, however, there is only one transaction and this consists of sale of all the four heaps together at one price per maund.

Yields and returns

The average yields are 900 lbs. in Charotar and 500 lbs. in Nipani. Taking the average prices per lb. as Re. 0-10-0 and Rs. 1-4-0

the gross returns are Rs. 562-8-0 and Rs. 625 respectively. Nipani tobacco is considered superior in quality and fetches generally twice as much as that of Charotar tobacco. Costs of cultivation maintained at the experimental farms work out to about Rs. 250 and 150 respectively, excluding overhead charges, such as interest on capital, land rent, depreciation etc. The costs are low at Nipani due to the lower level of manuring. On the basis of above figures the net returns per acre are Rs. 313 in Charotar and Rs. 474 in Nipani.

Processing

The entire crop is processed in the areas of cultivation and processing factories are found scattered in these zones. There are over 200 processing factories in the Charotar area. Processing consists of reducing the leaf pieces to small flakes and sieving them through graded sieves of 4 to 8 meshes to the linear inch. The midribs are crushed in power crushers and pieces of about $\frac{1}{2}''$ are mixed with leaf flakes. Smoking mixtures are prepared by mixing flakes and pieces of different sizes from different portions of produce according to requirements of buyers. The final mixture is passed through a 30 mesh sieve to separate dust and is bagged in gunny bags of about 100 lbs. each for transport.

Marketing

Bidi tobacco is marketed through middlemen. Up-country merchants place indents or send representatives to processors in the growing areas to select and purchase the produce required. The processors have their own agents and sub-agents in the villages for arranging transactions. Very often, due to speculation, unprocessed tobacco changes hands frequently from merchant to merchant before it is processed. The purchases and mode of payments differ widely due to different amounts of deductions for net weight and discounts for cash and deferred payments.

Bidi manufacture

This is mainly a small scale industry but there are large manufacturing concerns in Gondia, Saugor, Jubbalpore, Calcutta, Bombay, Madras and Delhi. Bidis are manufactured entirely by hand. The wrapper leaf generally used is *temru*, the main source of supply being the forests of Madhya Pradesh. Bidis are manufactured in two or three sizes but the most popular size is that which gives 1000 bidis per pound of mixture. The consumers' price for the popular size of bidi is As. 3 per bundle of twenty-five or Rs. 7-8-0 per 1000. The cost of manufacture of 1000 bidis is Rs. 2-8-0 and the Central Excise duty As. 14 per lb. of tobacco.

Production, exports and consumption

The annual production of raw bidi tobacco is estimated at 158 millions lbs. In 1951-52, 14 million lbs. were exported, the largest quantity going to Pakistan. The amount consumed in the country is about 120 million lbs. Leaf dust is an important bye-product which is largely utilised in the adulteration of hookah tobacco. Large quantities of unused stem dust are also destroyed every year.

HE WHO CULTIVATES HIS LAND BY BORROWING IS LIKE A MAN WHO LETS GO OF THE TREE HE IS CLIMBING.

SUGARCANE RESEARCH IN MYSORE

Retrospect and Prospect

By B. Venkoba Rao, B.Sc., M.S.

Sugarcane occupies an important place in the agricultural economy of the State. It is a coveted cash crop grown annually under forty-five thousand acres and providing the raw material for the production of seventy-five thousand tons of jaggery (Gur) and twenty-five thousand tons of sugar, the cash value of the produce being, at ruling rates, approximately five crores of rupees. The cultivation of sugarcane and the preparation of jaggery have been practiced from ancient times. 'Rasadali' was the original cane of Mysore. During the time of Hyder Ali 'Pattapatti' was introduced into the State. This soft and succulent cane with its rich juice and attractive colour spread itself throughout the State and continued as the dominant commercial variety, until the late. 20s of the present century, when improved high yielding varieties were introduced by the department. At the present day 'Pattapatti' continues to be grown over nearly eight thousand acres, but is being speedily replaced by improved varieties. Even to this day it is unrivalled as a chewing cane.

The Department of Agriculture has at all times taken a keen interest in the progress of the Sugarcane Industry. The first Government Agricultural Chemist, the late Dr. Lehmann (1904) started investigations on sugarcane and introduced the practice of liming cane juice before boiling—a practice that has now become an established routine. Systematic work on sugarcane became possible with the establishment of the Hebbal Farm near Bangalore and the Babbur Farm at Hiriyur under the Vanivilasa Irrigation Project. More recently, the opening of the Visvesvaraya Canal under the K.R.S. Irrigation system and the starting of an experimental station—V. C. Farm in the tract has been of great help in carrying out large scale field trials and intensive study of problems connected with sugarcane.

The work carried out so far may be considered under five broad headings, *viz* :—

1. Improvement of varieties,
2. Manurial requirements,
3. Agronomical and cultural aspects,
4. Insect pests and diseases, and
5. Jaggery and sugar manufacture.

1. Improvement of varieties

High yielding hardy varieties rich in juice quality and easy for processing are a pre-requisite of successful agriculture. The most widely cultivated varieties of sugarcane, until about 1920, were 'Pattapatti' and 'Cheni'. Pattapatti is a soft cane easily injured by insects, rodents and jackals and not able to withstand drought conditions. But under careful management it gave an yield of 30 tons or more per acre and produced jaggery of high quality. Cheni is a reed cane, hardy and drought resistant but gave a poor yield. It was confined to areas of low rainfall and inadequate irrigation facilities. The first step in the direction of improving yields was taken by

the introduction of exotic varieties of proved value into cultivation in the State. Red Mauritius, POJ. 100, POJ. 2878 and J 33A were among the more important of the varieties thus introduced. Of these Red Mauritius became established in the *Malnad* where it was liked on account of its hard rind which resisted the attack of wild animals, and POJ. 2878 for some time in the Factory area for its high yields. While the latter variety has completely been replaced by far superior varieties, a small area under Red Mauritius still continues to be under cultivation.

The next step was the breeding of new varieties and their acclimatisation to local requirements. The pioneer in this field of work was the late Dr. V. K. Badami, who took keen interest in sugarcane breeding from early period of his service. He obtained new seedling canes using both open fertilised seed of selected varieties—mainly POJ 2878, POJ 100. Red Mauritius and E. K. 8—and also from hybrid seed obtained from crossing selected high yielding types. His efforts met with early success in the selection and introduction of H. M. 320—a seedling cane of Red Mauritius, into cultivation. This is a thick cane, practically non-flowering and ripens in about twelve months. It gives an yield of 30 to 35 tons on an average, although yields as high as 100 tons per acre have been recorded. It has a high sucrose content and produces jaggery of high quality. This variety spread itself fast in all parts of the State and the establishment of the prosperous sugar industry in Mandya was made possible by introducing this variety. It was the sole variety grown in the Factory zone during the first ten years of the Factory, obtaining on an average, recovery of nearly 11%. In view of the work that had been already carried out and the results achieved in evolving high yielding superior varieties, the I.C.A.R. which came into being in 1929, granted a subsidy in 1933 for carrying out intensive work on sugarcane breeding at Bangalore and this scheme continued from 1933 to 1944. The scheme was renewed again in 1946 by the newly constituted Indian Central Sugarcane Committee and is being continued at the present time on an expanded scale. The programme of the Scheme as worked now, includes not only the breeding, selection and distribution of improved varieties, but also other important aspects of sugarcane cultivation, *viz.*, manurial and irrigational requirements, agronomical and cultural aspects and pests and diseases.

Under the I.C.A.R. Scheme breeding work on sugarcane was continued with renewed vigour and a number of new varieties were introduced. In addition to evolving new varieties in Bangalore, varieties released by the Sugarcane Breeding Station, Coimbatore were also obtained and tested under local conditions. As a result of this work Co. 419, a thick cane of vigorous habit and high yield and H. M. 320 became firmly established. Of other varieties evolved in Mysore and recommended for general cultivation the following are getting fairly well established.

H.M. 661, H.M. 647, H.M. 645 and I.C, 26. A few more promising varieties I.C. 136, I.C. 203, I.C. 215 and Co. 417 are at present being issued to cultivators on a trial basis. Of these I.C. 215 has proved to be very vigorous with an yield of 50 tons per acre.

A special feature of sugarcane breeding work in Mysore has been the utilisation of X-rays in the production of new varieties. Evolving new varieties of cane in the usual orthodox method and technique of breeding has its own limitations and is primarily dependent on the flowering character of varieties. A number of non-flowering varieties possessing very desirable qualities have been practically of no use to the plant breeder. This new item

of work on the utilisation of X-rays in sugarcane breeding work was undertaken with a view to explore the possibility of making use of non-flowering varieties of cane. The preliminary work carried out in this field so far has given very encouraging results. High yielding mutants have been obtained as s result of irradiating the buds of 'Pattapatti, a non-flowering rich cane. Further, a small percentage of flowering has also been induced and advantage of this in effecting crosses with some of the vigorous varieties has been taken. Some of the resultant hybrids are highly promising and one of the selected seedlings I. C. 206 is in the final stage of test.

2. Manurial requirements

A good deal of work has been carried out to determine the manurial requirement of sugarcane. Under Mysore conditions sugarcane does not seem to require the application of potassic fertilisers, unless it is grown intensively year after year. Phospates applied in the furrow at planting have not tended to increase yield but there is evidence to show that placement of the phospates 3 inches to 6 inches below the level of the setts has a beneficial effect. However, in the interest of balanced nutrition and to prevent undue depletion of the soil—our soils are rather poor in available phosphates, an application of about 20 lbs. of P_2O_5 (1 cwt. of Bone meal or superphosphate) per acre is considered necessary. Investigation on this problem is being continued.

Sugarcane responds readily to nitrogen the requirement varying from 400 lbs. per acre on light sandy soils to 200 lbs. on heavy soils. Part of the nitrogen—about 100 lbs., should be applied in the form of green manure and compost and the rest as a mixture of oil cakes and ammonium sulphate on equal nitrogen basis. There is no evidence to show that application of fertilisers in several divided doses is superior to application of the whole at one time but for practical convenience, application in three does, at planting and 8 to 14 weeks respectively is recommended.

Further work on the composition of different forms of nitrogenous manures is in progress under the Agricultural Chemist.

3. Agronomical and cultural aspects

(i) Seed rate and spacing :—Experiments on spacing and seed rates have shown that a spacing of 3 feet between rows and a seed rate of 10-12 thousand three-budded setts is the optimum.

(ii) Maturity and yields as influenced by time of planting :—

The main results obtained are (i) that cane planted from July to October takes 14-16 months to mature while that planted from December to March is usually ripe by twelve months. (ii) Yields are heavier in the case of July to October plantings. (iii) Most varieties continue to improve in sucrose content from October to March, unless they are overaged, lodged or otherwise damaged.

4. Insect pests and diseases

Systematic research on insect pests of sugarcane by the Government Entomologist have resulted in effecting remedial measures against the top shoot borers and stem borers which are the most serious pests in Mysore.

These measures are :—

(i) Light earthing up of the young cane at 8 weeks to bury the grubs in the soil and kill them.

(ii) Collection aud destruction of dead hearts.

(iii) Collection and destruction of moths and egg masses.

(iv) Release of Trichogramma parasites (in the case of the stem borers) and natural parasites found on egg masses (in the case of the top shoot borers) in the field.

5. Jaggery and sugar manufacture

As a result of extensive work, a double pan furnace run entirely on bagasse has been evolved and adopted. A method of preparing clean wholesome jaggery by treating the juice with activated carbon has been standardised and popularised. A process of preparing crystal sugar on a cottage industry basis has been standardised.

These then, represent some of the positive results of sugarcane research in the State so far. What of the future ? There are many new problems to be studied and solved and some old ones which have to be studied further.

Firstly, the breeding work has to be continued. It is a truism that no good variety lasts for ever. Morever it must be our constant endeavour to replace existing good varieties by still better ones and the only way of doing this is to continue and if possible, intensify the breeding programme.

Secondly, while the manurial requirement of sugarcane has been worked out, in a general way, there are bound to be variations in this respect between one locality and another. To fix the manurial requirement with reasonable certainty for different localities, simple field trials with different doses of manures, within the range of 200-400 lbs. of nitrogen already determined by experiments on Governments Farms have to be carried out on cultivators' fields in representative localities. Also problems of placement of manure, form of manure, time and method of application have to be persued further until precise results become available.

Much systematic work has yet to be done on irrigation requirement of sugarcane and definite correlations between the variety, manure and water requirement have to be established.

Not much work has so far been done on the problem of ratooning. Systematic work on methods of ratooning, time of ratooning, water and manurial requirements and economics of ratooning have to be worked out.

The problem of storage of jaggery is a serious one for the cane grower and the trader and also to the consumers. Investigation into causes that promote spoilage, and methods of control have to be undertaken. Storage methods recommended or in vogue in other parts of India have to be tried under our conditions.

There are many more problems, that could be listed, but these represent the most urgent, which we can take up and hope to solve within our resources and within a reasonable period of time. The Sugarcane Scheme now being subsidised by the Indian Central Sugarcane Committee has on its programme most of the problems listed and it is hoped that useful results would be forthcoming in the near future.

THE DEATH OF PLOUGH CATTLE AND THE DEATH OF ONE'S WIFE ARE EQUAL CALAMITIES.

THE PRESENT POSITION OF FODDER IN MYSORE

By K. Gopala Iyengar, M.Sc.
AND
B. Venkoba Rao, B.Sc., M.S. (La. U.S.A.)

The second world war and its aftermath have brought to light the constant and recurrent shortages of food and fodder in the country. A continuous succession of bad seasons have accentuated these shortages. The man in the street has been made aware of the role and importance of agriculture, as never before. The twin major problems confronting agriculture at the moment are to provide adequate food and fodder for all the men and the cattle existing at present. A long range problem is to provide adequate reserves, to tide over adverse conditions. Equally necessary is to plan for the increase in population both human and bovine, anticipated to occur.

Fodder in the State is derived from diverse sources. Of foremost importance is the straw of cereals and millets derived from cultivation. By-products of several legumes grown for their grain are also of considerable value. The area exclusively under fodder crops as such is very meagre, and the outturn of little significance. However, this is of some importance locally, since it helps the cattle to tide over emergent shortages. Other sources of fodder are, the grass in forest areas, *hullu banni*, *gomal* lands, and current fallows.

Recent survey (1951) of the cattle population in Mysore, reveals :—

		Heads
Cattle	...	4,688,999
Buffaloes	...	1,089,188
Sheep	...	2,708,659
Goats	...	1,585,506
Total	...	10,072,352

The number of poultry was 35.1 lakhs. Feeding habits of the several types given below indicate :—

		Cattle	Buffaloes	Sheep	Goat
Free Range grazing	...	80%	80%	100%	98%
Stall or yard fed	...	5%	5%	...	2%
Other types	...	15%	15%	...	...

that the open range maintains all the sheep and nearly all the goats in the country. The small percentage of goats, fed in stalls, consume exclusively loppings of trees and shrubs. Thus, actual provision, has to be made for a combined strength of 5,778,182 heads of cattle and buffaloes. Assuming a minimum provision of 15 lbs. of roughage per head per day (2.5 tons per head per annum), the annual demand amounts to 14,445,445 tons or say 14.5 million tons.

An appraisal of roughage, available from arable lands is presented below :—

Crop		Area in acres	Roughage in tons
Cereals and millets			
Paddy—*Oryza sativa*	...	800,000	
Wheat—*Triticum sp.*	...	2,000	
Jowar—*Sorghum vulgare*	...	550,000	
Sajje—*Pennisetum typhoides*	...	88,000	
Ragi—*Eleusine coracana*	...	1,950,000	
Harka—*Paspalum scrobiculatum*	...	110,000	
Miscellaneous	...	200,000	
TOTAL	...	3,700,000	5,550,000
		at 1.5 tons per acre	
Legumes			
Groundnut—*Arachis hypogaea*	...	275,000	
Thogari—*Cajanus cajan*	...	128,000	
Kadale—*Cicer arietinum*	...	32,750	
Hurali—*Dolichos biflorus*	...	775,000	
Avare—*Dolichos lablab*	...	121,500	
Hesaru—*Phaseolus aureus*	...	33,000	
Uddu—*Phaseolus mungo*	...	35,000	
Alasandi—*Vigna unguiculata*	...	22,250	
TOTAL	...	1,422,500	711,250
		at 0.5 tons per acre	
Fodder crops			
Jowar and grasses		250,000	500,000
		at 2.5 tons per acre	
Miscellaneous crops			
Sugarcane	...	50,000	
Sweet potato	...	2,000	
TOTAL	...	52,000	104,000
		at 2 tons per acre	
TOTAL	...		6,865,250

Grazing from bunds, thinnings, clippings, etc., may be expected to yield over half a million ton, thus bringing up the total from cultivated lands to approximately 7½ million tons. Thus, about 7 million tons of roughages have to be provided by sources other than agriculture. In other words, 2 8 million heads of cattle have to be provided from resources apart from those obtained from cultivated lands.

Forests cover an area of 4,703.88 square miles in the State. Assuming that 80% of the above is available for grazing and that 1 sq. mile will carry 125 heads, forests can be assumed to provide for 470,400 heads of cattle.

The area under natural grass apart from forests is chiefly made up of current fallows, *gomal* and *hullubanni* areas. This area fluctuates from season to season and the approximate present position would be,—

	Acres	
Current fallows ...	2,020,000	(Village open pasture).
Gomal ...	1,095,000	
Hullubanni ...	1,380,000	(Plantations from which grass is cut).
Total ...	4,495,000	

(Say 5 million acres.)

Stipulating that an area of 5 acres is needed to maintain one head of cattle, this area of 5 million acres will provide for 1 million heads of cattle.

The current position can be summed up briefly as follows :—

Cattle to be provided for (5,77,182) or 5.8 million heads.

	Million heads
Arable lands maintain ...	3.0
Forests maintain ...	0.5
Natural grass land maintain ...	1.0
	4.5

Supply falls short of demand, and about 1.3 million heads of cattle are left unprovided for.

POTATO CULTIVATION IN BANGALORE

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Potato was introduced in India only a little over a century ago. Potato is almost an inevitable vegetable in many of the edible preparations and a failure of that crop has resulted once in well known Irish famine. The home of Potato is South America and is now distributed over colder latitudes and to temperate zone. The range of temperature under which it grows varies from 55°-90°. In India, it is grown mostly in hilly regions of Bihar. It is also grown in plains where the climate is cool. In Mysore State, Bangalore, Kolar and very recently Hassan Districts have become intensive areas for Potato cultivation. In Bangalore District, Devanahalli, Hoskote, parts of Anekal are the potato growing areas. It can be grown both as a rainfed and irrigated crop, the latter being more common and the former being restricted to where rainfall is uniform and moderate. It can be grown upto 7,000 ft. above sea level.

Soils

The best soils are loams and sandy loams with good drainage. Light red and deep red loamy soils are typical in Mysore State. Good drainage is a fundamental factor in all cases.

Season and Rotation

Potato takes from 3-5 months to mature. The variety grown in Mysore takes 3-3½ months or even earlier. Potato is grown in two seasons, *i.e.*, summer and winter. In Mysore, summer crop is planted in April to June and the

winter crop more commonly known as *besike* crop is planted in October to December. In other parts of India, the planting season extends over longer periods, *viz.*, the summer spreading from February to April and winter from August to October.

In Mysore, especially *maidan* places, wells are the main sources for irrigation and mostly it is grown as a garden crop in rotation with a number of other garden crops. Where water is not plentiful, the *besike* crop of potato follows the main rainy season ragi crop or by chillies or garlic or sweet potato, there being only two crops altogether in the year. It may be cited here that ragi crop grown after the harvest of potato, has given promising yield.

If water is plentiful, potato (*besike*) crop may be followed by maize or by vegetables like cucumber, French beans, etc. The *besike* potato crop is the main crop and the rainy season crop is only on a small scale. This small crop is intended to raise seed for tubers for succeeding *besike* crop.

The seeds that are grown in hilly regions give a better yield in the plains.

Seed

The potato tuber itself is the seed material. The potato before planting should undergo a resting period which usually varies from 2 to 3 months and even 7 months in some varieties. The longer period of storage is a problem, as potato is subjected to deterioration by rot and potato moth. Moreover the storage must be under very cool conditions. The season why rainy season crop is chosen for seed purposes, is, that soon after harvest, the tubers can be stored under cool conditions in the winter months of October, November and December. Hence a small patch of land will be under potato in rainy season which evidently is grown for seed purposes for the *besike* crop. Generally, very few people raise their own seed in this way. The bulk of the seed material is imported from cool hilly portions of Simla, Nilgiris and Poona.

Indian grown potatoes from Bombay Presidency, Nilgiris and Mysore supplies the requirements of South India but South gets seed material from Simla also.

Cultivation

The cultivation is mostly done by manual labour. Digging has to be done to a depth of 18"-24" where the soil will come up in the form of clods. Such clods are allowed to weather for a period of one month. Then clods are broken. Roots and weeds are removed and ground is prepared to a fine texture and tilth. Further two or three light diggings are necessary before planting in order to loosen and to remove the newly sprouted weeds.

(*a*) *Manuring*.—Cattle manure to the extent of 40-50 cartloads per acre are generally applied which may go upto 100 cartloads. It is also in practice in Bangalore to apply wool waste from woollen mills and also leather waste, at the rate of 10-15 cartloads.

Artificial manures are also applied, in fact it is much used for potatoes. Potato though a lover of potash and phosphates (like many tuber crops), in India it is more in favour of nitrogenous manure, unlike in other countries where potash and phosphate form indispensable ingredients in potato mixture. Good yield has been reported by using half a ton of bone meal with 4 cartloads

of wood ash. However the dosage recommended is 4 cwts. of manure mixture consisting of 1 cwt. of ammonium sulphate, 1½ cwts. of concentrated super and 1½ cwts. of potash (Sulphate of potash). In Nanjanad potato farm (Nilgiris) mixture per acre is made of 500 lbs. of steamed bone meal; 300 lbs. of concentrated super; 224 lbs. of sulphate of potash.

The manure dosage varies from place to place depending upon the quantity of food material available in the soil. Hence no dead line can be drawn on this point of manuring except that better manure gives better yield upto a certain point.

(*b*) *Planting.*—The field after being brought to condition, furrows, are marked at 9"-12" apart. Further, beds of convenient sizes depending on the local practices are prepared to facilitate controlled irrigation. The beds should be watered before planting so that the soil may have optimum moisture for germination. Heavy watering should be avoided so that the seeds would not be subjected to *rot*. Seed setts (potatoes either whole or cut) are planted in furrows at a distance of 6" to 9" from each other with the bud facing upwards; to a depth of 2". The seed rate varies from 30 mds. (of 24 lbs.) to 40 mds. The beds are not watered for 3 days from the date of planting. Light irrigation is given once in 3 days and interculture or removing the weeds is done once in 3-4 weeks. Tubers begin to sprout in a week, and in 10-15 days plants are fully grown up. The rows are then earthed up by splitting the ridges and making them into furrows. During weeding care should be taken to see that sickles do not hamper the young tubers that are under formation which lie close to the surface at a radius of 4" from the main stem.

When the crop is one month old, it should be sprayed with calcium arsenate mixture which acts not only as a control against the beetle (Epilachna) but also as a preventive fungicide for the *Alternaria* disease; both pests take a heavy toll of the crop, if not protected, in time.

To a small extent, potato is raised under rainfed conditions in the districts of Kolar, Hassan and parts of Bangalore. There is not much difference in cultivation except that furrows are ploughed at 18" apart both lengthwise and crosswise laying the field into 18" squares, at whose intersections, a whole potato is planted. In Dharwar, furrows for planting are made at 2 feet apart and tubers planted at 18". In fact for large scale cultivation under rainfed conditions, this is quite suitable.

It is better to cut the seed potato and then plant both from the economic point of view as well as scientific. When the potato is cut into pieces with one more or "Eye" buds it is possible to recognise whether it is affected by the ring disease which is recognised by a brownish ring, *i.e.* near the margin of the potato. Such affected potatoes look apparently healthy for outside appearance. It is better to cut the seed potatoes with the knife which should be dipped in a glass of dilute potassium permanganate soon after it cuts accidentally an affected (ring affected) potato. The ring disease which is a deadly disease (the symptoms of which is sudden wilking of the plant and death) can be best avoided at the time of seed selection and planting cut seeds; which goes a long way in reaping a good harvest. Any amount of cultivation and manuring would never compensate the tremendous loss for which the ring disease will be responsible and hence it is worthwhile to take pains for avoiding this disease which is contaminative and seed borne and which has no other control measures.

The period of duration of the crop from the date of planting to harvest varies from 3 to 3½ months. The yields are generally 10 fold but depending on the cultivation it may not be surprising to expect a possibility of 40-50 fold crop.

During the harvest, tubers should be dug carefully without bringing or cutting to avoid damage in storing. Then they are heaped up in the ground with haulms covering it over a week, when the tubers dry a little and skin adheres more firmly to it. The large growers keep the stock for some time more to avoid slump and to get a good market value.

Storage methods vary from heaping to highly temperature controlled methods. Storage can be undertaken up by storing the potatoes to a height of about 1 foot and covering it with a layer of 2" of sand. As heat develops, the sand is romoved and potatoes are left to aeration and again sand is covered. A thin layer of Gammexane D.024 over the potatoes would further prevent the moth attack.

In large storage in western countries, it is stored between 35 F-40 F which is found very effective against the deterioration which varies from 20 to 50%. There are special fumigating chambers which our ryots can hardly afford.

Varieties

Potatoes can be differentiated on the colour of the other skin, the duration of the crop, the size of the potato, the shape, and the quality of the flesh of the tuber. There are potatoes purple in colour. Sizes are oval and some are flat and the so called "Kidney potatoes" are also known.

Potatoes are classed as waxy potatoes and the mealy potatoes. The waxy when cooked does not hold whereas the later will be firm and holds together.

Varieties in Mysore.—Are only two in number, *viz.*, the round many eyed waxy potato called Dharwar—which is acclimatised Italian variety and (2) large flattish oval mealy potato called Ricketts. The latter takes 2 to 3 weeks less, to mature than the former. Nilgiris which is a supply centre to South India grows largely two varieties, *viz.*, Great Scot a large round potato with several deep eyes and the Royal Kidney which is a large flattish oval; white fleshed and mealy variety.

Pests and Diseases

This is already referred to under cultivation. The unfailing pest is the Epilachna beetle which voraciously punctures the leaves and actually leaves the plant with skeleton of net work of veins almost with an appearance of withered plant. This can be easily controlled by spraying calcium arsenate mixture when the crop is 3 weeks old which otherwise will be subject to a loss of 50 to 60%.

Disease.—Ring disease which is spoken off previously is a seed borne disease which causes a great havoc to an extent of 70% almost reducing the crop to nothing. Ring affected seedlings should be avoided and the early affected plant should be pulled out and the pit burnt with small quantity of hay. It is highly contagious and precaution is the only method of saving the crop. The symptom is that crop suddenly wilts.

Early Blight

This is not as serious as the ring disease. The symptoms can be recognised by the blotches on the leaves in the form of black concentric rings. Prevention with 1% Bordeaux will save much of the crop.

Production and Trade

The total average in India is 4,48,700 acres of which 90% is grown in hills. Mysore has 5,700 acres. The annual production in India 1,700,000 tons. In addition, India imports 50,000 tons every year.

Potato apart from being a staple semi-food crop, it is utilised in the production of alcohol. A ton of potato is reckoned to yields 20 gallons of 95% alcohol which is such an important industrial product.

Potato is also converted to dried potatoes known as "Sliced" or "Shredded" potatoes and are prepared on a large factory scale. Farina is a starch product from potato which is largely used in textile industry.

There is also a small export of potatoes from India to the extent of 4,000 tons. The export is mainly from Mysore accounting to 45% of total exports and that of Madras is 31%.

—••o••—

THE PRAYER OF THE TREE

(A notice found nailed to a tree in one of the parks of Seville, Spain)

To the Wayfarer—

Ye who pass by and would raise your hand against me
Harken ere you harm me!
I am the heat of your hearth on the cold winter nights
The friendly shade screening you from the summer sun
My fruits are refreshing draughts
Quenching your thirst as you journey on
I am the beam that holds your house
The board of your table
The bed on which you lie,
And the timber that builds your boat
I am the handle of your hoe
The door of your homeshed
The wood of your cradle
And the shell of your coffin
I am the bread of kindness and the flower of beauty
Ye who pass by, listen to my prayer; harm me not.

—*Quoted by Roy, E. Biles in his "The Complete Book of Garden Magic"*

CROP VARIETIES FOR DIFFERENT SEASONS AND REGIONS

FROM THE ECONOMIC BOTANY DIVISION

Variety	Strain No.	Description	Remarks
		Ragi—*Eleusine coracona*	
Ragi 1	K. 1	Sowing season—April-May Duration—4 months Nature of earhead—Green compact Yield—1,250 lbs. per acre	A selection from Kolar gidda ragi. Suitable for the *kar* areas in Mysore and for irrigation during summer as well as monsoon season.
Ragi 5	R. 0871	Sowing season—April, May Duration—125 days Violet compact ear heads Yield—1,300 lbs.	A selection from E. C. 47 of Coimbatore. A late variety for the *kar* tracts of Mysore and Hassan districts
Ragi 3	R. 0009	Sowing season—April, May Duration—4 months Green compact earheads Yield—1,350 lbs.	A re-selection from K. 1 having a more uniform maturity, and slightly better in yield. May replace K. 1 with advantage.
Ragi 4	R. 0862	Sowing season—April, May Duration—105 days Violet compact earheads Yield—1,300 lbs.	A selection from mixtures found in E. C. 2985 of Coimbatore. Suitable for Belur taluk and *kar* areas of Hassan and Mysore districts. May also be grown as an irrigated crop, only during summer.
Ragi 22	H. 22	Sowing season—July Duration—4½-5 months Violet, long open earheads Yield—1,640 lbs.	A selection from Madayyanagiri local. Advocated for *hain* areas all over the State.

Ragi	R. 0870	Sowing season—June-July Duration—4½ months Violet compact earheads Yield—1,640 lbs.	A selection from E. C. 47 of Coimbatore. Advocated for *hain* areas all over the State. It is earlier than Ragi 22 by 1-2 weeks.
Ragi 10	R. 0883	Sowing season—July-August Duration—125 days Green compact earheads Yield—1,410 lbs.	A selection from mixtures found in Dharani ragi. Is suitable for late sown *hain* areas in Tumkur and Kolar particularly on light soils.
Ragi 8	R. 0833	Sowing season—June-July Duration—135 days Violet compact earheads Yield—1,330 lbs.	A selection from mixtures found in Dharani ragi. An early variety for the *hain* areas. It is slightly earlier than Ragi 9. The straw outturn of this variety is poor.
		Irrigated Ragi	
Ragi	R. 0324	Sowing season—Summer Duration—110 days Violet long branching earheads Yield—2,400 lbs.	A selection from Coxcomb or local Hulimavu. The variety is early and high yielding, and can be kept pure with comparative ease due to the branching nature of the earheads. Is liable to shedding.
Ragi 7	R. 0786	Season—Monsoon Duration—120 days Green compact earheads Yield—2,800 lbs.	A selection from *nati* ragi of Kolar, suitable for transplanting after potatoes. Late and high yielding. Tumkur, Kolar and Bangalore districts and Challekere taluks.
		Same—*Panicum miliare*	
Same 1	St. 32	High yielding strain isolated from local types	Northern Chitaldrug, Tumkur, and N. E. Kolar.
Same	St. 33	Do	Do

CROP VARIETIES FOR DIFFERENT SEASONS AND REGIONS—(*contd.*)

Variety	Strain No.	Description	Remarks
		Hejjave	
Same 3	St. 53	Vigorous, hardy, drought, resistant. Produces not only grain but considerable forage.	Mandya, Tumkur and Kolar.
		Navane—*Setaria italica*	
Navane 1	Red Navane	Local selection. Compact earhead. Bold red grain. 10-15% more yield over white type Yield—5 pallas of grain per acre N-2.07% Starch-5%	Chitaldrug and northern portions of Tumkur.
		Haraka—*Paspalum scrobiculatum*	
Haraka 1	St. 113	High yielding grain type	Bangalore, Tumkur, Mandya, Chitaldrug and wherever Casuarina is grown.
		Baragu—*Panicum miliaceum*	
Baragu 1	Madhugiri, white	White seeded high yielding grain type	Light soils in Kolar, Tumkur and Chitaldrug.
Baragu 2	Chintamani, black	Black seeded type	Do

		Oodalu—*Echinochloa frumentacea*	
Oodalu 1	St. 100	High yielding grain type, a local selection	Northern Tumkur and north-eastern Kolar can be also treated as a fodder crop.
Oodalu 2	St. 97	Dual type giving high return of both straw and grain	Do
		Jola—*Sorghum vulgare*	
Jola 2	S. 2	Selection from local bili jola, compact earhead Yield—400—450 lbs. of grain 1000—1,500 lbs. of Kadbi Duration—5 months	Advocated for the ***hingar*** bili jola areas in Mysore, especially Chitaldrug district.
	S. 2-2	Further selection from S. 2. Semi compact earhead. Duration—4½-5 months Yield—450-500 lbs. of grain 1,000-1,500 lbs. of Kadbi	Do
		Sweet Potato—*Ipomoea batatas*	
Hosur green	...	Local selection Duration—4-4½ months Yield—8 to 10 thousand lbs. per acre Tuber—Straw yellow with purple splashes	All over the State, wherever the crop is raised.
Hosur red	...	Local selection Duration—4-4½ months Yield—9,000 lbs. per acre	Do

CROP VARIETIES FOR DIFFERENT SEASONS AND REGIONS—(*contd.*)

Variety	Strain No.	Description	Remarks
Deenabandhu	...	Locat type Duration—4 months Yield—8,000 lbs. per acre Tuber—Red, irregular, surface with many eyes	All over the State wherever the crop is raised.
		Thogari—*Cajanus cajan*	
Thogari 1	C. 21	Local selection. Early type suited to red soils.	All over the State, except black soils in Chitaldrug district.
Thogari 2	Tho. 155-016	Local selection. Medium maturity suited to red and white sandy loams.	All over the State, except black soils in Chitaldrug district and suitable for *kar* areas of Mysore and Hassan.
Thogari 3	C. 1-1	Local selection: Long duration. Suited to black cotton soils.	Chitaldrug district.
		Bengalgram—*Cicer arietinum*	
Kadale 1	Gundlupet 4	Local selection. Early. Duration—85 days. Yield—570 lbs. per acre. Habit—Erect to semi-erect Seed—Dark brown	All over the State wherever the crop is grown.
Kadale 2	Nagamangala 4	Local Selection. Early Duration—85 days. Yield—660 lbs. per acre. Habit—Plants upright—branches spreading Seed—Dark brown	Do

Kadale 3	Chamaraja-nagar 3-3	Local selection. Medium Duration—95 days. Yield—540 lbs. per acre Habit—Erect Seed—Dark brown	Do
		Soya bean—*Glycine max*	
K. 16	K. 16	Java variety. Vigorous Seed—black seed coat. Yellow cotyledon Yield—800-1000 lbs. per acre	Can be grown as a dry crop during *hain* season, and as a green manure.
White mammoth	White mammoth	American variety Smaller than K. 16, less hardy and profusely hairy Seed—Cream coloured. Cotyledon yellow Yield—700-800 lbs. per acre	Can be grown as a summer crop, or as a dry crop in *kar* area. It is early for the *hain* season, and the ripe pods are invariably damaged by late rains.
S. B. 1	V. C. F. 1	Selection from acclimatized soya bean. Erect compact, densely covered with hairs. Maturity—110-115 days. Seeds—Cream coloured. Yield—1000-1300 lbs. per arce.	Is a recent release and has not been widely tried as yet.
		Horsegram—*Dolichos biflorus*	
Hurali 1	Black Hurali	Local selection. Vigorous compact. Pods arise in bunches. Thin and long. Seeds—small, with black shining hard seed coat. Nitrogen—3.86% Protein—24.13% Yield—700-1000 lbs. per acre.	As a grain and green manure crop all over the State.

Variety	Strain No.	Description	Remarks
		Groundnut—*Arachis hypogea*	
H. G. 4	G. 0343	Habit-Semi—erect. Duration—4 months. Yield—750 lbs. per acre. Pods—Long finger like, net like vines on surface. Seeds—Red—3-4 in pods. Shelling—66%, Oil—48%	Can be grown all over the State, especially near large towns, for the roast trade. It is not a miller's variety.
H. G. 5	G. 0195	Green manure type. Habit—Erect Duration—5 months Yield—750 lbs. per acre (pods) 6000 lbs. per acre green matter Pods—Pronounced net like—2 seeded Seeds—Flesh coloured.	Can be grown in *hain* areas, where rainfall is adequate or the soil is heavy.
H. G. 6	G. 0689	Similar to H. G. 5 Habit—Erect Duration—5 months Yield—625 lbs. per acre (pods) 6000 lbs. per acre green matter Pods—Large, constriction prominent Seeds—Rose coloured.	Do
H. G. 7	G. 0558	Habit—Spreading Duration—4¾ months Yield—558 lbs. per acre (pods) Seed—Dark Red Shelling—79%, Oil 50%	Tumkur and Kolar districts and portions of Mandya and Mysore.

H. G . 8	G. 0416	Habit—Bunch Duration—2 months Yield—558 lbs. per acre (pods) Seed—Dark red Shelling—79%, Oil 50%	All localities where Spanish is grown.
H. G. 9	G. 0553	Habit—Bunch Duration—4 months Yield—539 lbs. per acre Seed—Light Rose Shelling 78%, Oil 49%	Do
H. G. 10	G. 0577	Habit—Bunch Duration—$4\frac{1}{2}$-$4\frac{3}{4}$ months Yield—887 lbs. per acre Seeds—Rose Shelling—74%, Oil 49%	Bangalore and Tumkur districts.
		Castor—*Ricinus communis*	
E. C. 1 E. C. 2 E. C. 3	L. 53 L. 54 L. 242	Local selections. Duration—6-8 months Capsules—Green—Spiny Yield—250-300 lbs. per acre Oil content—47% L. 54—Dark brown seeds—White caruncle L. 54—Light brown—Brown caruncle	Mysore, Mandya, Hassan, Bangalore and Tumkur districts.
M. C. 4 M. C. 5 M. C. 6	L. 73 L. 74 L. 77	Selections from Mattihalli Capsules—Large, green, spiny Duration—$4\frac{1}{2}$-6 months Yield—350 lbs. per acre Oil content 52%	Other areas except above.

CROP VARIETIES FOR DIFFERENT SEASONS AND REGIONS—(*concld.*)

Variety	Strain No.	Description	Remarks
...		L. 73—seeds brown caruncle brown L. 74 Seeds—Dark brown L. 77 Caruncle white	
M. C. 7	L. 280	Re-selection from Hyderabad Capsules—Large, rose, spiny Duration—4½-5 months Oil content—48-49% Seeds—Green	For hedges in Kolar and Mandya, round sugarcane plots.
Not named as yet	Bosy Castor	A selection from local type. Is also ornamental. Can be sown from May to July Duration—5 months Yield—348 lbs. per acre	Has just been released in Chitaldrug district.
		Cotton—*Gossypium Sp.*	
Sel. 69		Selection from Local Sannahatti (Herbaceum), Staple—18-21 mm. Ginning—28-30% Yield—250-300 lbs. per acre of seed cotton Counts—30s (H.S.W.C.)	For black cotton soils in the State.

M. A. V.	...	Cross between Co. x Uganda Long staple variety Staple length—28 mm. Ginning outturn—35% Yield—800 lbs. per acre of kapas under irrigation Counts—36s (H.S.W.C.)	Red soils and under irrigation.
Giza 7 Giza 12	...	Egyptian Cottons. 600-700 lbs. per acre of kappas; still under small scale trials.	Regional adaptability is being ascertained.
Hybrid Bajra	Bajra B	This is a fodder type, a profuse tillerer. Very vigorous stands, three cuttings in a year with an average yield of 20 tons of green matter per acre. Raised mostly under irrigated conditions.	Can be grown all over the State.

QUALITY JAGGERY

By K. Lakshminarayana Bhatta, B.Sc.
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What is 'quality' in jaggery ? It is mainly a combination of colour and taste and complete freedom from dirt. A golden yellow colour, hard grain, and a sweet taste devoid of any saltish or acid flavour, represents the best standard of quality. This can be achieved by attention to a few details and the excercise of care and judgment in the choice of material and in its handling. The main thing is to know what to do and what to avoid and use our knowledge to advantage.

The raw material

The starting point for good quality jaggery is good ripe sugarcane. Both immature cane and overaged or lodged cane contain less cane sugar and more invert sugar than properly ripe cane. Juice from such cane does not set properly and if more lime is added, as is often done to induce setting, the jaggery becomes dark and saltish.

The maturity of a cane crop can be judged by means of a hand refractometer. In ripe cane sugar is distributed evenly in all parts of the stalk, from top to bottom. In an immature cane, the top portions contain less sugar than the bottom portions. If the 'brix' reading of the top joint and bottom joint of a cane is taken, the two values will be nearly the same if the cane is ripe, 'brix' representing the total solids in the cane juice, of which sugar is the chief constituent. Ripe cane gives a brix reading varying from 18 to 22%. By taking the brix reading of twenty to thirty canes chosen at random in an acre field, by means of the hand refractometer, the state of maturity of the crop can be judged. Farmers who grow sugarcane regularly year after year would do well to possess this instrument. It is handy, reliable, easy to use and lasts a life-time or longer. It costs about Rs. 253.

Those who cannot afford a refractometer have to depend upon their personal experience and a knowledge of the age of the crop. With the varieties now in cultivation in the State, sugarcane planted from December to April ripens in twelve months, that planted from July to November in fourteen to fifteen months and that planted in April or May can be harvested only the following October, when the crop is eighteen months old.

Arrowing is no proof of maturity. The arrow is the flower of sugarcane. Like other flowering plants which flower in particular seasons, flowering varieties of sugarcane arrow during October and November every year. While it is true that a cane stalk which has arrowed ceases to grow, there is possibility to accumulate sugar and become sweeter. Also, all the canes in a stool do not arrow (except in a few varieties) and those that don't arrow, continue to grow. The age of the crop and not its arrowing should, therefore, be the guiding factor in judging maturity.

Ratoons mature about a month earlier than plant cane.

Harvest

At harvest, the cane must be cut close to the ground as the bottom portions are the richest in sugar and contribute most to the outturn of jaggery. It should be topped just above the last coloured joint, or if the tops are to be used for setts, two joints lower. It must be freed from all trash, and as far as possible, the buds must be scraped off as they contain no sugar, but much tannin, which makes the jaggery dark. The cut cane should be stored in

shade and milled without undue delay. Storage for more than twenty-four hours during summer causes serious drying and inversion, lowers the quality of the juice and consequently of the jaggery.

Milling

Keeping the mill clean is of great importance. It should be cleaned with plenty of water at the end of each milling. Otherwise, the juice held in the mill parts will get sour and spoil the next charge of juice. The juice coming out of the mill should be filtered through a rough cloth to keep out pieces of bagasse and other coarse dirt.

Clarification

The filtered juice contains, besides sugar, many other substances, such as the colouring matter of the cane, gums, resins, proteins and minerals present in the cane. Some of these are in solution and the rest in a very fine state of suspension or colloidal solution. The art of making good jaggery consists mainly in removing these suspended non-sugars, and boiling the resultant juice without allowing the sugar to invert or break down to invert sugar during the process.

It is worthwhile pointing out to readers that invert sugar is not an 'impurity'. It is a wholesome article of food, sweeter than sugar, and highly palatable. It is formed when a solution of sugar is treated with an acid or boiled for a long time. Its presence or formation in large amounts, during jaggery boiling, makes the jaggery soft, poor grained and of inferior keeping quality. Hence the objection to its presence in juice, or its formation during boiling, which should be avoided.

The removal of suspended non-sugars is brought about by heat or by the action of chemicals or by both. Their removal in this manner is referred to as clarification and the chemicals used as clarifying agents.

Some clarifying agents

Lime is the most common clarifying agent used in Mysore. Addition of lime to the juice causes the impurities to be thrown out or 'coagulated' and on heating it, these float to the top as "scum" or "mud." A thorough removal of the scum leaves the juice clear, bright and transparent.

While most jaggery makers in Mysore are now accustomed to the use of lime the method followed in many cases is not satisfactory. They use lime powder, which often contains a lot of grit and stone. Also, in their anxiety to get hard jaggery, they add too much of this powder so that a dark saltish product is obtained.

The best way to use lime is as 'lime cream.' This should be prepared every day or alternate days and stored in an air-tight container. For this purpose, freshly burnt quick lime is slaked, stirred well and filtered through a coarse sieve. Metal sieves used for *soji* are satisfactory. Four to five seers of water added to three pounds of lime gives a good cream.

Lime cream should be added to the cold juice, avoiding an excess. This can be done in one of two ways. To a pan normally boiling nine tins of juice, eight tins are filled, and lime cream added until the juice turns a piece of red litmus blue, or if litmus is not available, till the colour of the juice turns a faint permanent yellow. The last tin of juice is then added. Alternatively, fill

the pan and add lime cream a little in excess, and then add a solution of super-phosphate till the yellow colour just disappears, or a red litmus paper just fails to turn blue. The superphosphate solution can be prepared by shaking a double handful of superphosphate in four seers of water, and allowing to stand for sometime, the clear liquid on top being then decanted and used.

The lime cream added for the first charge on a day is noted and is used for all subsequent charges that day with cane from the same field.

Mucilaginous extracts

Mucilaginous extracts from certain plants are used extensively in upper India as clarifying agents. They are added to the hot juice after the first scums are removed. Their addition causes further scums to form and rise to the surface and their removal leaves the juice clear.

One such plant commonly available in Mysore is '*Bende*' or Ladies finger[1] cultivated as a vegetable. The stems of grown up plants are beaten down to pulp and squeezed in water between the fingers. A mucilaginous extract is obtained. This is filtered through a fine cloth and used in the following manner. The raw unlimed juice is boiled and the scum that floats up is removed. Then about one seer of the extract prepared is added and the boiling continued. Fresh scums arise and are carefully removed. The extract is added one or more times till no more scums are formed, and the juice boils clear, with a white foam. The juice is then concentrated as usual and struck into jaggery.

With fresh ripe cane, this gives a good quality jaggery. It is not quite so hard or granular as jaggery prepared with lime clarification, but both the colour and the flavour are pleasing.

Activated carbon

The use of activated carbon for clarification of juice in jaggery making is coming into vogue. Activated carbon is chemically prepared charcoal which has the property of absorbing and retaining, colouring matter, colloids and minerals contained in the juice. Jaggery of a very attractive golden colour, called cream jaggery can be obtained by the use of this clarifiant. The method of preparing cream jaggery has been extensively demonstrated at exhibitions, fairs, Government farms and on cane growers' fields. The product finds a ready sale and fetches a higher margin of profit than ordinary jaggery. The commercial possibilities of this type of jaggery are great and well worth exploitation.

The process requires some small additions to the ordinary outfit of a jaggery house. They are, two or three sand filters and a wiremesh skimming ladle both of which can be made locally. Their description is given at the end of this note. The process of clarification with activated carbon is briefly as follows.

Juice is taken in the top pan of a double pan furnace and limed as usual and the first scums are removed. Then activated carbon in amounts equal to $\frac{1}{2}$ to $\frac{3}{4}$ lb. per 100 lbs. of juice is added and the juice stirred briskly for a couple of minutes. Heating is stopped and a little cold water sprinkled on to the juice and it is allowed to stand. In about 10 minutes, the major part of

1. OKRA—*Hibiscus esculentus*.—ED.

carbon will have settled down to the bottom of the pan, leaving a clear liquid on top. This is drawn to the strike pan, through a sand filter over which a piece of cloth is spread. The sand filter retains practically all the carbon particles, and the filtered juice in the pan in now nearly colourless, but contains some particles of carbon floating in it. The juice is then heated and scums as they arise are removed with the ladle fitted with wiremesh. About quarter seer of dilute milk (one part of milk to 4-5 parts of water) is splashed on to the boiling juice once or twice. This helps to collect the carbon particles together and facilitates their quick and complete removal. The further boiling and concentration of the juice is the same as with ordinary jaggery.

The success of the process depends to a large extent on thorough cleanliness. The sand filters have to be washed at the end of each day's work and the contents renewed periodically.

A three pan furnace has been designed to facilitate continuous working of the process, in which the topmost pan is used for carbon clarification and the other two pans for concentration and striking. With this furnace five to six charges of clean jaggery can be prepared in the course of a 10 hours day.

Hydros (Sodium hydro sulphite)

Another chemical that is coming into use in the preparation of jaggery is hydros. It is not a clarificant in the strict sense of the word, as it is not added to the juice and does not clarify it. It is added to the hot syrup just before striking or in the cooling pan immediately after striking. It is mainly a bleaching agent, which bleaches the colour of the syrup giving a light coloured jaggery. For good results, the syrup must be stirred briskly after addition of hydros so that all parts are equally well bleached. The use of hydros is to be deprecated, as it is likely to be harmful to health if used in large amounts and as the improvement in colour is quite temporary. One tola per charge of 9 tins is perhaps the safe limit.

Besides these substances, several others are used as clarifying agents in different parts of India. These include the mucilaginous extracts of plants like *deola* (Hibiscus ficulneus),[1] *Semal* tree bark (Bombax malabaricum),[2] *Phalsa* (*Grewia asiatica*)[3] and *Sukhali* (*Kydia calicina*)[4]; chemicals like sodium carbonate and bi-carbonate, alum, superphosphate and *sajji*[5] (a crude form of sodium carbonate with sodium sulphate and chloride) and extracts of oil seeds like castor and groundnut.

Boiling

Correct boiling is as important as thorough clarification. The success of boiling depends to a large extent on the type of furnace used. The Hebbal double pan furnace is designed to subserve this purpose very well. It is easy to construct and maintain, economical and works on bagasse. The top pan can be used for clarification and the bottom pan for striking, making the process continuous.

The scum must be removed very thoroughly. Jaggery makers usually put the scum on to a cloth spread over a basket and allow the juice to strain through it into the pan. This is a good practice, provided the cloth is cleaned regularly once or twice during the day. The loss in recovery of jaggery due to removal of the scum is negligible and is more than compensated by the

1. ಸಣ್ಣ ಕಾಡುಬೆಂಡೆ. 2. ಬೂರಗ. 3. ತಡಸಲಿ ಅಥವಾ ಜಾಣ. 4. ನಾಯಿಬೆಂಡೆ ಅಥವಾ ಕೋಳಿ ಬೆಂಡೆ. 5. ಚೌಳುಪ್ಪು.—ED.

improvement in the quality of jaggery and the higher price it fetches. The scum makes good manure.

The side of the strike pan must be rubbed down periodically with the *goramane* (ಗೊರಮನೆ) dipped in the hot juice to wash down any syrup adhering there. This prevents concentration and charring of the syrup on the sides of the pan.

The firing of the pan towards the end of boiling must be steady and even. After the final froth subsides and the syrup begins to boil with memerous small bubbles the striking point is near at hand. The syrup at this stage must be kept continually stirred to prevent local heating and charring.

The striking point must be judged properly. This is a matter of expert experience. Well trained jaggery makers generally strike the syrup properly. The usual method of judging is to dip the palm of the hand in cold water and collect a little syrup between thumb and forefinger. On rolling this syrup and striking the ball formed on to the pan, a sharp metalic sound indicates the strike point. A more accurate method is to use a thermometer and strike the syrup when it is 117 to 118°C. But ordinary thermometers, are liable to break unless handled carefully and are rather costly. Special instruments called 'Rabometers' which indicate the strike point accurately have been designed by the Institute of Sugar Technology, Kanpur, but these have yet to be introduced in Mysore.

Finishing

The cooled syrup is either run into moulds to set or rolled into balls of various sizes. Of these two methods, running into moulds is the better practice. It requires less handling and is consequently cleaner. Since the pieces are all of one size and weight, it facilitates packing and transport. The wooden mould designed by the Department offers several advantages over those commonly used by jaggery makers. It is made of sections which can be taken out, cleaned and re-assembled with ease. When set to take the syrup, it allows some of the molasses to run through, giving a harder and better jaggery. The use of this type of mould on a wide scale is to be advocated. In some places, the hot syrup is run on to mats and when set, is cut into slabs. In such cases, the mats must be protected from wind and dust and renewed frequently.

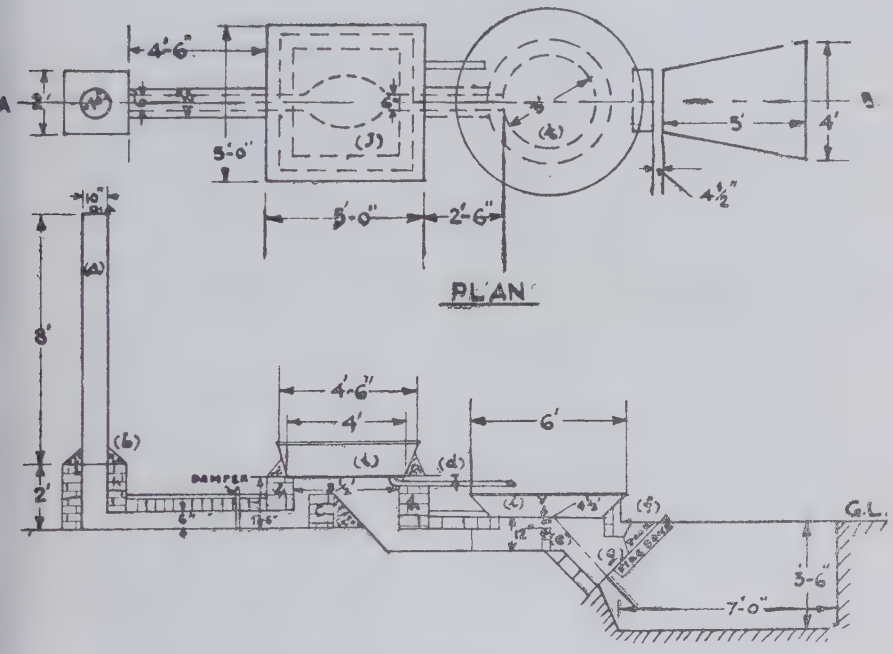
Fresh jaggery from the moulds is slightly moist and liable to collect dirt. It must be packed in clean trash or gunny and stored in a dry place.

It is better to grade the jaggery according to quality. As jaggery prepared in different parts of the State varies within wide limits, in colour, composition, shape and size of bits, it is difficult to work out a statisfactory standard of grading purposes. The Indian Institute of Sugar Technology, has put up a system of grading based on colour and composition of jaggery. It would be in the interest of both producers and comsumers to bring this system into use.

The composition of jaggery varies somewhat with the variety, the state of maturity of cane and other factors. But the main constituents * are cane sugars (60 to 85%), invert sugar (10 to 15%), moisture (3 to 6%) and ash 2 to 5%). All these are derived from the cane, except a portion of the ash which may have come from the clarifying agent used. Good quality jaggery is low in ash and moisture and high in sugar content.

* Taken from Gur Monograph by S. C. Roy.

HEBBAL FURNACE



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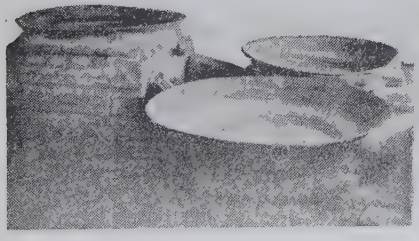

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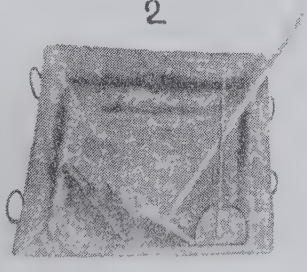
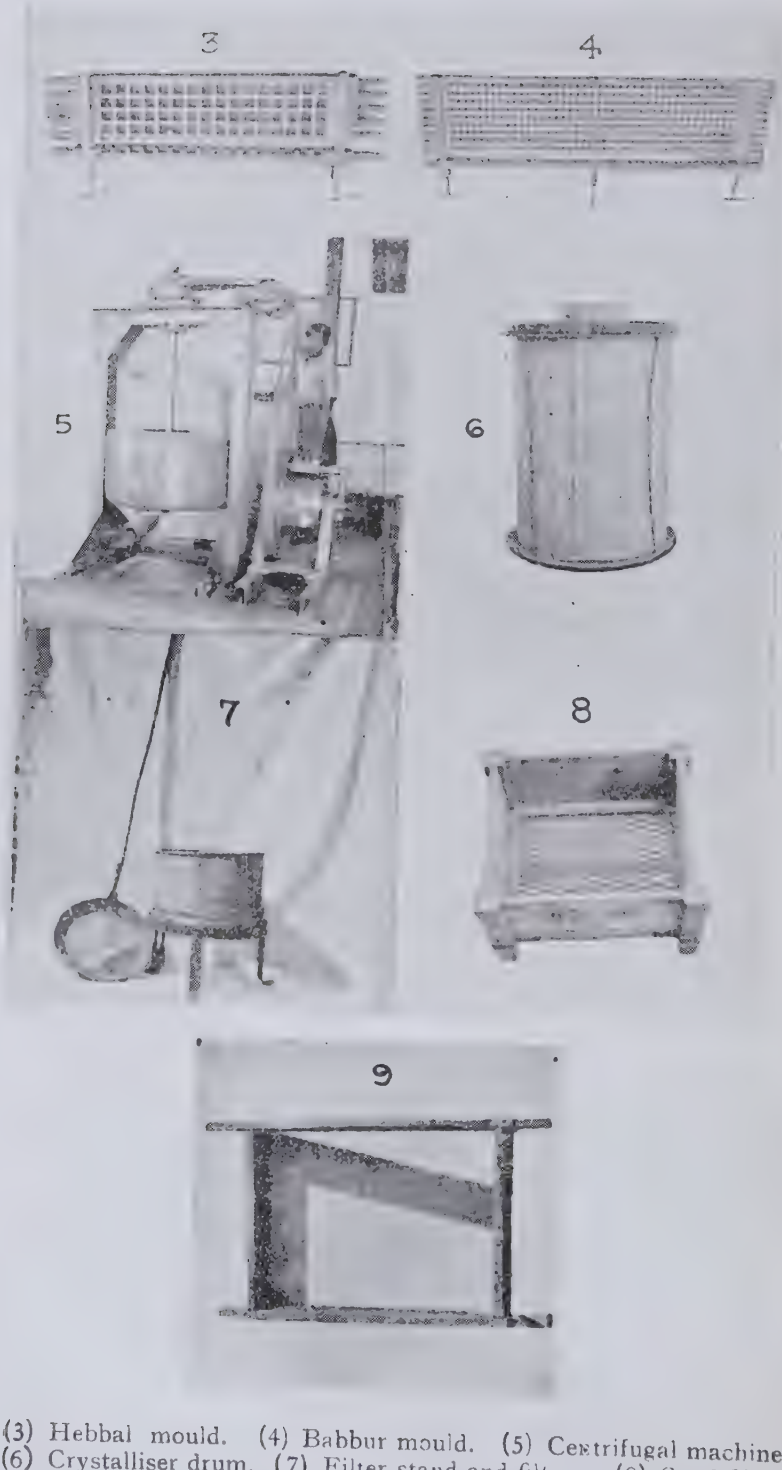


(1) Jaggery boiling pans. (2) Cooling pan and scraper (*Gorumane*)



(3) Hebbal mould. (4) Babbur mould. (5) Centrifugal machine. (6) Crystalliser drum. (7) Filter stand and filter. (8) Sand filter. (9) Sieve for crystal sugar.

Jaggery is an article of food which is peculiarly Indian. It is delighful and nourshing. It is an ingredient of our daily food. No feast is complete without a dish containing jaggery, and few rituals social or religious in which jaggery has not a recognised place. It is valued constituent of many Unani and Ayurvedic medicines. It is too important a commodity to be treated with neglect. We owe it to ourselves that we produce only the very best quality.

I wish to acknowledge grateful thanks to Sri B. Venkoba Rao, B.Sc., M.S. (La. U. S. A.), Government Economic Botanist and Sugarcane Research Officer for his kind interest in the preparation of this note and his kind scrutiny of the manuscript.

APPENDIX

Sand filter

For making the sand filter, an old bucket is taken and the bottom removed. A wire frame is fixed in its place and wire gauze cloth of mesh 80-100 is placed on the wire frame and soldered. The bucket is then supported on a tripod.

River sand is washed thoroughly dried and sieved, so as to separate fine sand from coarse sand. The bottom of the bucket filter is filled with coarse sand to a depth of 4" and then a similar layer of coarse sand. On top of this, paddy huskchar (prepared by charring paddy husk and washing it thoroughly) is spread to a depth of 2 inches. A cloth spread over this complets the filter.

Skimming ladle

This is simply an ordinary skimming ladle in which the perforated metal ladle is replaced by a fine wire cloth, supported on a wire frame.

PREPARATION OF CRYSTAL SUGAR BY THE OPEN PAN PROCESS

By K Lakshminaryana Bhatta, B.Sc.
Assistant Chemist

To most of us, crystal sugar is synonymous with factory white sugar. It is associated in our mind with huge modern factories, where truck loads of sugarcane enter at one end and bags of sugar roll out at the other. But not so very long ago, sugar was primarily a product of small scale manufacture on the farm of the cane grower. Even to-day, in the Uttar Pradesh and certain other parts of the Indian Union, crystal sugar is produced on a cottage industry basis. In Uttar Pradesh it is an important industry and a great deal of attention has been devoted to its improvement. Many technological improvements in the manufacturing process have been introduced, which have resulted in upgrading the quality and increasing the recovery of sugar produced. This industry once flourished in Mysore and there is no reason why it should not be revived. During the past few years a method of preparing crystal sugar on a cottage industry basis in Mysore has been evolved and its practicability demonstrated by systematic work both on Government farms and on private estates. The method is less elaborate than that now being popularised in Uttar Pradesh but is suited to our requirements and resources. It deserves an earnest trial at the hands of enterprising cane growers.

The principles underlying the preparation of sugar from sugarcane, whether on the farm or at the factory, are essentially the same. The sugarcane is milled and the juice is filtered to remove coarse dirt. It is then heated and treated with chemicals (clarifying agents) when part of the non-sugars is thrown out as scum or mud. This is removed by filtration and the juice concentrated to a syrup. At the proper stage of concentration, the syrup is transferred to 'crystallisers' where it is slowly cooled. A major part of the sugar then separates out in the form of crystals, the mixture of crystal and syrup being known as 'Rab'. This rab is 'cured' in a centrifugal machine, which retains the sugar and throws out the residual syrup or molasses. The molasses can be concentrated again, to give a second crop of sugar. This may be repeated a third time. The final or exhaust molasses obtained still contains some sugar which cannot be separated by further concentration. The sugar obtained is washed, dried, rolled to break down lumps, graded and bagged.

The essential difference between the process as adopted in the factory and that on the farm is, that in the factory the juice is concentrated under reduced pressure in vacuum pans heated by steam, while on the farm it is concentrated in open pans heated directly by bagasse or other fuel. For this reason, sugar produced by this process is called open pan sugar. The percentage recovery of sugar by this open pan process is three or four per cent less than in the factory, but this disadvantage can be offset by converting the molasses, into a wholesome edible product like jaggery. The process advocated in Mysore is based on this principle.

Equipment

For this process, certain additional equipment, over and above what is available in a normal jaggery boiling unit are neccessary. These are (1) a 10 H. P. motor or oil engine, (2) a centrifugal machine capable of taking a load of 20-30 lbs. of rab, (3) a crystalliser, (4) a two-gallon sprayer and (5) a thermometer reading to 150°C. Minor accessories, such as mats and carpets for drying sugar, basins, trays, etc., are also necessary.

The crystalliser, as the name indicates, is a receptacle for inducing the sugar in syrup to separate out as crystals. The object to be achieved is firstly, to make as much as possible of the sugar to crystallise and secondly to make the individual crystals to grow as big as possible. For this purpose, the syrup should be cooled very slowly and stirred now and then to maintain the whole mass at nearly the same temperature. Stirring also prevents the formation of lumps. The essential features of a crystalliser are that it should be insulated to prevent rapid cooling of the rab and that it should have a stirrer arrangement. The simplest type of crystalliser is a big copper pot (ಹಂಡೆ) or wooden barrel with a capacity of about twenty-five gallons. This should be wound round with a double layer of straw roping, excepting the mouth, and stitched up with a double layer of gunny. A wooden beam of suitable length and slightly broader at the working end, serves as a stirrer. It should be closed with a tight fitting wooden board similarly insulated on the outside. For continuous working with a double pan furnace, three crystallisers of this type will be required.

The Bilari Research Station has designed and put into use a revolving crystalliser, which can be worked by hand or geared on to a motor. Comparative tests carried out here in 1942-43 showed that it offered no advantage over the above type either in the size or the recovery of crystals, or in the

time required for crystallisation. More recently, the same Institution has put up a U-shaped crystalliser with stirrer attachment, but this has not yet been tested in Mysore. For our present purpose, the simple crystalliser described above may be considered adequate.

Centrifugal machines suited to our requirement are available in the country. Machines put on the market by the Kirloskar Company and by M/s. Berry Bros. of Calcutta are satisfactory.

The motor or oil engine which is used to drive the cane mill can also be used to drive the centrifugal machine.

The other accessories can be procured locally at a small cost.

The process

The clarification and concentration of the juice are the same as indicated under quality jaggery. Either lime and superphosphate, or lime followed by active carbon can be used as clarifiants. In the latter case, a whiter and cleaner product is obtained. The clarified juice is then concentrated until the temperature rises to 108° to 109°C, as indicated by the thermometer. The syrup is transferred to a cooling pan at this stage where it is stirred with a wooden ladle until it cools to about 90°C and is then poured into the crystalliser. The crystalliser is closed tight and allowed to stand. The strike point can be judged, after a little practice, from the appearance of the boiling syrup and its feel when a drop is pressed between finger and thumb, but it is always safer to use a thermometer to prevent any over-heating.

The crystalliser has a capacity of twenty-five gallons and can take in the rab from five to six charges, *i.e.*, the total syrup from a days working. As each fresh charge is poured into it, the contents are stirred once. After all the charges are added, it is closed tight and left to stand. It should be open once every two hours, stirred slowly with the stirrer and closed again. At the end of three days, the rabs will have cooled down to room temperature and the crystallisation will be complete. The contents are then poured into large basins and prepared for spinning. The crystalliser filled the first day will be available for filling again on the fourth day so that with a set of three crystallisers, the process can be continuous.

The rab is then taken in basins and any lumps formed broken up by gentle pressure with a small wooden mallet. It is then centrifuged in the machine, washed once or twice with a spray of cold water, using a two gallon sprayer till the washings indicate that the sugar is free from molasses and the sugar is then taken out. It is dried on carpets or other cloth spread out in the sun. The sunlight, besides drying it, has a bleaching effect. The sugar is then rolled to break down lumps and bagged. A recovery of 6 to 6.5% is obtained.

The molasses still contains a good deal of sugar and this can be worked up by concentrating the molasses and allowing it to crystallise further. A recovery of 1.0 to 1.5% of second sugar is obtained, bringing the total recovery to 7.0 to 7.5% on cane.

This still leaves some molasses on hand and to throw it away would mean the loss of much precious nutritional material. To obviate this difficulty, the method proposed is to recover first sugars and to mix the first molasses with fresh juice and prepare jaggery. The molasses jaggery thus prepared is just as good as that from raw juice, both in appearance and taste.

Molasses jaggery is prepared as follows. Two hundred pounds of fresh juice are clarified and boiled to syrup till the temperature rises to 108°C. Then 60 lbs. of molasses are carefully neutralised with lime cream, poured into the pan aud thoroughly mixed. The combined melt is then concentrated and struck into jaggery in the usual manner.

From a series of tests carried out it has been found that the most economical way of preparing open pan sugar is to prepare first sugars and convert the first molasses to jaggery.

It may be mentioned here that in Uttar Pradesh the Bilari Institute has been popularising the sulphitation process, in which sulphur-di-oxide is used for clarification of juice in the production of open pan sugar. Additional equipment, such as, a sulphur tower, settling tanks, special furnaces, etc., have been devised for the purpose. The process is reported to be popular with *khandsaris* (open pan sugar makers) and to result in a high recovery (7 to 8%) of good quality sugar. Whether these improvements can be adopted in Mysore is still a question to be settled by actual tests and pilot scale experiments. It would however seem that under our conditions, and in the present state of development of the open pan industry, the process would be much too elaborate and it can be considered only when the simple process described above becomes well established.

The production of crystal sugar by open pan process, described above, has been successfully demonstrated at several districts and Dasara exhibitions. The economics of the process has been carefully tested by large scale tests on Government farms as well as on two private estates, one at Bhadravathi and one in Kolar District. These tests were carried out some years ago when sugar was scarce and jaggery prices were low. The costs and profits have perhaps to be worked out afresh in the context of current prices, but there seems little doubt that with proper care, the process can be worked with good profit to the cane growers.

The process described here is based on an unpublished note by Dr. B. T. Narayanan, former Joint Director of Agriculture and Sri M. Subbiah, Retired Agricultural Chemist, to both of whom my grateful acknowledgments are due.

I wish to acknowledge my gratitude to Dr. S. V. Govinda Rajan, B.Sc. (Hon.), Ph.D. (Lond.), D.I C., A.R.I.C., Agricultural Chemist for his kind interest in the preparation of this note.

INSECTS AND THE AGRICULTURIST

By B. KRISHNAMURTI, B.Sc.

Government Entomologist

Insects form four-fifths of the world population of animals. No other animal affects man and his interests as closely and as widely as insects do; and generally speaking not a single sphere of human activity is left unaffected by them.

Insects form a vital link in the process of crop-raising and production of food and other essential commodities. They act as very serious competitors in agricultural production by claiming an appreciable share in it for themselves. The agriculturist has thus been constantly faced with the problem of fighting out these competitors in order to protect and save his crops.

Crop-protection in India has generally long been looked upon by the average agriculturist as a function very subordinate (or even wholly unnecessary) to other agricultural operations like cultivation, sowing, manuring and weeding. In the event of an invasion of insect pests on his crops, he usually treats the matter in a very philosophical and negligent mood. There appears to be a rooted feeling in him that insect pests are one of the several necessary evils of this world and would, in most cases, be put down by merciful God, and he, himself need do little or nothing about it, and he hardly ever realises that personal effort in the removal of such evil is also very important and necessary.

Whatever are the causes that have led to the subordination of crop-protection or crop-pest control to the general agricultural operations practised as a routine, it is high time that the agriculturist evinces as much active and personal interest and keenness in the matter of the control of crop-pests as in other matters. He cannot be blind to the fact that, crop-pests if left uncontrolled promptly and effectively, would undo the results of all his labours in other directions; for, it is well-known and fully borne out by long experience that no crop, and not a single stage of any crop in the field and the harvested grain in the store as well, is free from the ravages of a large variety of insect pests season after season. At the present juncture the need for constant vigilance and timely and adequate and effective control of insect pests of crops, is all the greater and more urgent. No agriculturist can justifiably remain indifferent and complacent. Nor is it fair that a few agriculturists alone do the work and others remain negligent; because the good results expected of timely and adequate action taken by the few, would get vitiated by the negligence of others in the neighbourhood. General food crops being usually cultivated in contiguous blocks over large stretches of land, will have to receive attention simultaneously from all the cultivators of any area, if useful results are to be achieved, in the protection of crops. A co-operative effort on the part of all the agriculturists in any area would be most necessary and desirable in the interest of all.

A natural sequence in the work of the Division of Entomology of the Department of Agriculture in Mysore, is the devising of suitable methods for the control or suppression of insect pests in order to save the crops from damage and destruction. The methods are finally meant for adoption by the agriculturist. In this work, certain basic factors such as the illiteracy and poverty of the average ryot and the smallness of the agricultural holdings are constantly borne in mind so as to make the methods of control fit into the prevailing condition of the agriculturist and the general agricultural economy as perfectly as possible.

There is wide scope for the agriculturist to make beneficial use of a number of mechanical and cultural methods of a simple nature which at the same time cost very little, and are also highly practicable and effective. A close attention is continually paid to the development of such methods first; only when no scope exists for such methods, are others of a somewhat complex (but by no means beyond the capacity of the agriculturist) nature involving the use of chemical and other substances (insecticides) and simple machinery are worked out. In the case of quick control of insect pests of a very serious nature and over extensive areas, chemical and other insecticides would necessarily have to be used with the help of mechanical and power-driven sprayers, or dusters. This inevitably increases the cost of control operations but the results achieved, in the shape of protection of crops and higher yield production would be highly commensurate with the extra cost.

The agriculturist is fortunate in that, Nature has provided, in her scheme, an effective counter-competition to crop pests in the shape of certain groups of beneficial insects whose life-work consists of destroying the injurious pests. Were it not for the counter activities of these beneficial insects (parasites and predators), the well-known and very important "Balance of Nature" in the insect world, allowing no one species to multiply unduly at the cost of others could not exist and the agriculturist alone would never be able to control the destructive activities of crop-pests with the varied means at his disposal, however potent they may be.

In the absence of man's interference in Nature's scheme, this "Balance" would in most cases, effect necessary adjustments to prevent any severe competition of insect pests against the agriculturist's production. But interference big and small, with Nature's set up being more the rule than otherwise in the ever-changing economic and other conditions, and occurrence of occasional floods, droughts and spells of excess, heat and cold and such other natural phenomena, usually and often very seriously disturbing the "Balance" the inevitable result is that various species of injurious insects find themselves free to develop and multiply beyond the limits normally imposed upon them and assume the status of serious pests. It is then that the agriculturist would have to, irrespective of his willingness or otherwise, adopt artificial means (mechanical, cultural, chemical and biological) of destroying the excess insect-pest populations in order to reduce their level to the normal or minimum and thus help in the restoration of the "Natural Balance" as far as possible and at the same time to protect and save his crops from damage and destruction.

Recent developments in the field of insecticides, have brought out certain complex and poisonous chemical compounds that are capable of effecting very quick and spectacular controls against a large number of insect-pests of crops. Some of these have the character of serving as all-purposes insectcides against most varieties of pests, which often leads to their indiscriminate use by the agriculturist. The greatest objection to such indiscriminate use is the destruction of many beneficial and economically useful insects (noted above) that form an integral part of any insect population in any habitat and that co-exist with the different pests of crops in any locality. These insecticides suffer from the serious defect of not being selective in their action because they usually destroy both the beneficial insects (friends of the agriculturists) and the injurious pests (enemies of the agriculturists) alike. Their residual action is another objection to their use. These are, indeed, very serious matters, and proper care should therefore, be exercised in the selection and use of powerful chemical insecticides. A highly desirable scheme of control of insect-pests of crops would be a combination of natural and artificial methods by means of which the beneficial insects in nature are encouraged and preserved, while the injurious insect pests are destroyed. The temptation to use these new chemical insecticides is really very strong since they serve as a sort of general panacea for most insect troubles of the agriculturist. But the best way for the agriculturist to ward off the temptation is to constantly bear in mind, that, by their indiscriminate and blind use, the parasitic and predatory insects that are highly beneficial to the agriculturist are also destroyed along with the injurious insect pests that affect his crops, thus killing friend and foe alike.

The large volume of matter available in the Division of Entomology in respect of all the known insect pests occurring on the several staple food crops, garden and plantation and orchard crops cultivated in Mysore, is always at the disposal of the agriculturist. A large number of publications in English and Kannada dealing with the insect pests has been printed and widely distributed. Any interested agriculturist may avail of them either at the Government Entomologist's office at Bangalore or at the offices of the Assistant Directors of Agriculture in the several districts.

RECENT ENTOMOLOGICAL INVESTIGATIONS AND DEVELOPMENTS IN PLANT PROTECTION

By Dr. M. Puttarudriah, B.Sc. (Hons.), M.S., Ph.D.
Joint Entomologist.

The following are some of the recent investigations done in Division of Entomology of the Mysore State Department of Agriculture.

Guava *Kajji*

Blister disease of guava is very common wherever guava is grown; and the exact cause of this trouble was not known till recently, though the damage bore a resemblance like plant disease. Recent investigations and observations showed that the blisters were caused by a bug, *Helopeltis antonii* Signoret, commonly known as the tea mosquito, which pierces its beak for sucking the sap; such feeding punctures resulted in the scab or "*Kajji*". It has been recorded that two fungi enter into such punctures. Whether the scab is due to toxins introduced by the bug through its saliva, or the invading fungi is to be investigated. If it is the latter, whether the fungi are air-borne, or introduced by the bug, has also to be investigated. But it is now established that the primary cause is the feeding punctures of the bug. Laboratory experiments confirmed this observation.

The morphology and life cycle of the bug were studied. The nymphal instars and the adult bugs both cause the damage on fruits of all sizes, ovary of the blossoms, and also tender leaves and stems. The punctures soon are turned brown and later black, resulting in the common scab or "*kajji*", each of the punctures being raised, warty and hard. Cracks appear later and blisters are formed. If punctures are too many, they coalesce and form patches. Badly damaged tender fruits dry up and drop on the ground. The damaged leaves and stems become curled up and wither.

The bug has several host plants, having been noted on guava, cashewnut, acacia, etc. Extensive damage is caused by the bug to guava fruits even when the number of the bugs is small, as each of the nymph or the adult has been observed to make numerous tabs on a single fruit, and attack many fruits.

The damage can be prevented by controlling the bug, with a preventive spray or dust. Any contact insecticide will kill the bug. A liberal dusting with Gammexane D.0.25, (gamma isomer 0.6 %) was tested and advised to the orchard owners who tried and were satisfied with the results. As the incidence of the bug is severe in bushy plants, it is advised to trim the plants and open up the interior of the bush to allow plenty of air and light so that shelter for the bugs is lessened.

The results were passed on to the plant protection staff; and they have been advising and demonstrating this method of control of the blister disease among the cultivators.

Honge bug (*Cyclopelta siccifolia*)

Among the pests of the Honge[1] tree, a useful and economical tree to the cultivators, *Cyclopelta siccifolia* a Pentatomid bug commonly called stink bug, was found to be quite severe in the Nagamangala-Bellur areas. This bug attacks the trees and is found in clusters of hundreds of them, resembling a

(1) *Pongamia glabra.* Karanj (Hindi). A common tree in Mysore.—Ed.

bee colony. The egg laying habit and life cycle of this bug had not been studied. It was found that the bugs laid eggs heavily in linear rows on twigs, during May and nymphs were observed in June-July. The nymphs also suck the sap and become adults by about December. Many trees were said to have dried up as a result of continuous sucking of sap by thousands of these bugs. Detailed studies regarding the several instars, host range, etc., are being studied. In the meanwhile, in the interest of the cultivators, control measures had to be devised. Of the several insecticides tested, spraying of Honge oil resin soap, 1 lb. in 6 gallons of water was found to give effective results on the bugs. Gammexane D.025 if dusted well on the clusters would also be effective. In nature the eggs are heavily parasitised.

The cultivators are being now advised by the plant protection staff about the control measures of this pest.

Tamarind seed borer

Tamarind is another useful and economical tree, the seeds of which are used in industry and to a limited extent for medicinal and food purposes in times of scarcity. It was recently investigated that the seeds were attacked by a weevil, *Sitophilus linearis* which is much like the store weevil, *S. oryzae*, but bigger in size; the latter also being found in tamarind seeds sometimes.

The tamarind seed borer is primarily a store pest but infection is found to start even in ripe pods on the trees, and then carried to the store. The grub feeds on the seed and by the time the larva completes the development, the seed is practically eaten inside the empty shell.

The weevils multiply rapidly in the containers and in about 4-6 months not a single seed is left in a sound condition.

The biology and bionomics of this pest were studied in full, and control measures were devised.

The infected seeds must be fumigated; and Killoptera was fouud to be an effective fumigant when used at the rate of 30 lbs. per 1000 c.ft., and the seeds exposed for 72 hours. The healthy seeds can be stored with a 2 inches layer of sand on top of the seeds in the bin.

Though tamarind seed has little money value, because of its use in industry, and also as the pest is likely to spread from infected seeds to other hosts, control measures may be necessary; and the plant protection staff can well advise these measures to the cultivators and industrialists.

Mangohoppers

The mangohoppers are common and serious pests of this fruit tree. Though many insecticides were tested on a small scale now and then, no large scale effective control had been worked out. Recently, D. D. T. 50% wettable powder dissolved at the rate of 1 lb. in 20 gallons of water and sprayed against the hoppers, was found to give consistent results and was very satisfactory when tested on a large scale in several places. A preventive spray to cover the flower spikes and tender twigs and fresh flush of leaves is very necessary, before the blossoms open out; and the spray may be repeated once again after six weeks. A power worked sprayer for this work has been found very useful and economical in completing the operation quickly and thoroughly. The plant protection staff has been advising D. D. T. 50% wettable powder spray against mangohoppers; and the orchard owners who have tried this control measure are thoroughly satisfied.

Control of *Othesia insignis*. Lantana Bug

Orthesia insignis an imported pernicious insect was found to be spreading from lantana to several economic plants. It is a mealybug, which multiplies rapidly and sucks the sap of the plants, which soon wither and dry. It was mistaken for a beneficial insect for destroying the lantana weed. The Division of Entomology had to warn the cultivators and the public not to trust this insect and take all measures possible to eradicate it. Its host range has been found to be extensive, there being not less than 80 different economic plants, of which some 30 were recently investigated.

The lantana bug is a very resistant insect and several insecticides tested had given only partial control. Recently a synthetic phosphatic compound Folidol E-605, 46.6% con.— Diethyl paranitrophenyl thiophosphate, gave the most satisfactory control when a 0.05% solution was sprayed, the mortality being 100% in 24 hours, the residual effect lasting for nearly 3 weeks, after which, a second spray would be necessary. This control measure is recommended wherever lantana bug is seen on ornamental and economic crops.

Pyrilla on Sugarcane

Pyrilla has been a serious pest of cane in North India, and in Mysore State, it was rarely found. But during 1951, this pest on cane in the V. C. tract was found in large numbers for the first time. A survey for its incidence was made and found that though the pest was seen in large numbers, it was not as serious as in North India. The pest was also seen on jola. The intensity of the pest declined after December, and became scarce again in 1952.

The life history of the pest was studied in a general manner, and to nip it in the bud, control measures were immediately devised. Several insecticides were tested both in the laboratory and fields. D. D. T. 50% wettable powder as a spray and Gammexane D.025 as a dust were found to be satisfactory insecticides. Gammexane dusting was taken up on a large scale in the fields and the pest was controlled in time.

Cutworms

In recent years cutworms were found to be a serious pest on Ragi, Jola, Potato, Vegetables and other crops. The caterpillars hide during the day under clods, and begin their activity after dusk. They cut the seedlings at the base and thus destroy the plants.

Poison bait with Sodium silicofluoride, bran and jaggery was found to be very effective and was advised to the cultivators. It is now being regularly advocated by the plant protection staff.

The poison bait is prepared as follows:—

One part of Sodium silicofluoride is mixed with 8-10 parts of wheat or rice bran and a little jaggery dissolved in water is added to the mixture. In place of Sodium silicofluoride. Calcium arsenate or Gammexane D.025 may be used. The bait must be wet and is scattered at the base of the plants, on the bunds, etc. in the evening. The cutworms feed on the bait and die. If the attack is in the nursery, Gammexane D.025 may be dusted at frequent intervals.

Gammexane on pests of Jola, Ragi and Paddy

Jola forms the staple food crop of Mysore District and is grown in about 2,00,000 acres. From 1944 the crop is attacked by the ear-head bug commonly known as "*Arukalchitte*", the ear-head fly and the ear-head webbing

caterpillar. The first two attack the tender ear-heads and suck the sap from the milky grains, leaving them chaffy. The webbing caterpillar attacks the older ear-heads, cutting the grains into bits and forming webs in which they live. The damage by all these three pests is extensive and occurs regularly every year.

In recent years, in the absence of Jola crop, the webbing caterpillar has been found to have taken up to Ragi earheads extensively causing great loss in certain localities. The pest is found to attack the standing crop with well-developed earheads and also the earheads in stacks.

Of the several insecticides, fine soap powder and nicotine dust mixture was found effective and used in large scale demonstrations. Recently Gammexane D.025 has been found to be equally effective, when dusted into the earheads on standing crop or stacks.

The paddy crop is subject to several insect pests. Of the external feeders caseworm, Leptispa, swarming caterpillar, are important. The caseworm is of general occurrence all over the State, the Leptispa being severe in *Malnad* Districts, and the swarming caterpillar of local importance when it breaks out. To these, may be added the skipper, the butterfly and the *Cnephalocoris* caterpillars which are all defoliators. All these external feeders are easily controlled by a liberal dusting of Gammexane D.025, which is both a contract and a stomach poison. It is a cheap and potent insecticide and is available in all the Agricultural Depots. The plant protection staff has been advising the use of this insecticide on all the important pests of the above cereal crops.

Aphis on Groundnut

In Chitaldurg District, the groundnut crop is attacked by aphis which causes extensive damage, in all the areas. Round about Davangere the attack is seen in about 30,000 acres. Year after year, inspite of repeated advice and persuasion, the cultivators notice the attack very late when the incidence of the pest is severe and treatment difficult, as the insecticide cannot reach the pest at the base of the plants. By experience, it is found that a preventive treatment is necessary to control the pest. Hence, the cultivators are advised to take up dusting of Gammexane D.025 according to the following schedule.

First dusting of the insecticide after one week of seeds sprouting.

Second dusting of insecticide after three weeks of seeds sprouting.

Third dusting of insecticide when the crop is a month or 5 weeks old.

Fourth dusting when the crop is seven weeks old.

In place of Gammexane, Hexyclan 5% dust may be used.

In places where water is available D. D. T. 50% wettable powder may be used for spraying at the rate of 1 lb. in 16 gallons of water.

Castor Semilooper

Castor is an important oil seed crop, and is cultivated in the State on more than a lakh of acres. It is subject to many insect pests of which the semilooper popularly called "*kondlihula*" is the most serious. It occurs wherever castor is grown and inflicts serious loss, as the crop is completely defoliated overnight. The cultivators are familiar with this pest, as it can be easily recognised from its shape, which is like a bent bamboo of a "*pallakki*". In Mysore State, Tumkur District suffers most from this pest.

As the caterpillars destroy the crop very quickly, the cultivators should not wait till they appear for taking up control measures. As it is a routine pest occurring in the months of October—December, preventive measures are very necessary. Beginning in the month of October, all the growers of castor must dust Hexidole or Gammexane 5% on the leaves once in two weeks; or spray DDT. 50% wettable powder 1 lb. in 16 gallons of water. If the plots are small and the caterpillars are just seen, handpicking of them and destruction by putting them in kerosened water may be adopted. Boiled rice may be scattered on the plants to attract the crows which greedily devour the caterpillars if seen by them. Healthy castor plots may be protected by digging V-shaped trenches, one foot wide and one foot deep, all round When the caterpillars are collected in the trenches, they must be collected together and killed.

These measures have become popular and are being practised by the agriculturists.

IMPORTANCE AND PRINCIPLES OF STORAGE

By D. Seshagiri Rao, B.Sc.
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There is a growing awareness of the importance of scientific storage of grains during the last 8 or 10 years mainly on account of the Grow-More-Food campaign on the one hand and the monopoly grain procurement and distribution (rationing) activities of Government on the other. There is also a gradual realisation of the enormous losses sustained by grower and trader alike by defective storage practices although this has not brought about any substantial improvement in the methods employed in villages and *mandies*. The National Planning Commission has taken cognizance of the need for continuity of effort to bring home to the trade the advantages of scientific storage.

The agents mainly responsible for spoilage and deterioration of grains are (1) insects (2) rodents and (3) moisture. This fact is well known but there is perhaps no proper appreciation of the colossal losses sustained through these destructive elements. No precise estimate exists, but nearly 10 years ago, it was officially stated that about 30 lakh tons are going to waste annually in this country. This represents roughly the cereal requirements of the entire population for *two weeks* at one pound per day per head!

Scientific storage, has, naturally to take the existing limitations into account, as it is not possible to bring about a total reformation, at all levels overnight. Even working within the frame-work of these limitations, it is possible to save a substantial portion of the present waste, by employing scientific methods of storage. This requires a proper understanding of the conditions under which these adverse forces work and the methods by which they can be overcome. The expenditure incurred in putting these scientific processes into operation will be but a fraction of the value of grains saved from destruction.

(i) *Insect.*—Stored grains all over the world are attractive to some specific insect-species, which live, feed and grow on them. Thanks to a world-wide commerce in food-stuffs, some of the grain-insects like Rice Weevil and Rice Moth have established themselves all over the world. The effect of a serious infestation in a quantity of grain is to progressively reduce its

edibility and nutritive value besides rendering it unattractive by the accumulation of waste powder, fragments, dead and disintegrated insects, cast skins, droppings, larval webbings, etc.

The main store insects fall into two insect orders, *viz.*, beetles and moths. They may be further divided into (1) *borers* that tunnell into grains, and (2) *scrapers* that scrape away food from the surface of the grains. The important beetle pests are (*a*) Rice weevil (*Sitophilus oryzae*) which is enemy No. 1 of stored cereals (*b*) flour beetle (*Tribolium sp.*) attacking milled products, like soji, atta and flour, and (*c*) pulse beetles (*Bruchus Sp.*) which attack pulses. There are two important moth pests, *viz.*, Rice Moth (*Corcyra cephalonica*) which attack a large variety of stored products and paddy moth (*Sitotroga cerealella*) a pest on paddy and jola.

(ii) *Rodents.*—The destructive role played by rats and bandicoots is too well known to need elaboration. Their prodigious fertility and destructive propensities can be judged by the fact that one pair of rats breeding normally will result in 800 descendants in a year and 100 rats will eat up about 10 bags of grain in the same period! Many times the quantity actually consumed becomes unpalatable and unwholesome by the rats spilling it about and dropping their excreta in it.

(iii) *Moisture.*—Grains tend to assume a state of equilibrium with the surrounding air as regards their moisture content, *i.e.*, moist grain stored in a dry place gives out some of its moisture, while dry grain taken to a humid place will absorb moisture. This is however a gradual process. Moisture content of grain is of great importance in so far as it determines whether the grain is susceptible to insect-attack and invasion of moulds and bacteria. Thus grain with less than 8% moisture content is too dry for insects to thrive on it, while above 15 or 16%, fungal and bacterial attack sets in. It is therefore a safe practice to store only dry grains and to ensure that moisture does not accumulate in excess of the safe limit, particularly in rainy months, by aeration and periodical turn over of stocks.

Principles of storage.—Obviously proper storage consists in preventing conditions under which these three destructive agents can flourish. Under ideal conditions with small parcels of grains it is possible to ensure freedom from deterioration for an indefinite period. But in regard to storage of bulk grain certain inherent limiting factors have to be considered; for example, the gunny-bag though allowing free access to insects and easily torn by rats is a convenient and cheap receptacle for grains which cannot be dispensed with at present. The principles, briefly enunciated below may be taken as a guide to proper storage under the existing conditions. Constant vigilance is the key to this problem, as it is to most other human activities.

1. The grain should be thoroughly dry before storage. It is not necessary to determine the moisture content of each lot, as it is possible to say from experience whether any stuff is not as dry as it should be. If slightly moist grain is to be stored, during rainy months, when sun-drying is not possible, it has to be stored in a place where it can be aerated well, and it should be used for consumption at the earliest opportunity.

2. The godown or granary should be dry and airy inside; the windows should be kept open during a part of the day for proper aeration of the stocks.

3. For grains intended for long storage, it is necessary to have some insulating stuff called 'Dunnage' between the floor and the bottom layer of

bags, to prevent the absorption of moisture by the latter—paddy-husk, bamboo-poles, wooden-battens or bricks can be used.

4. Removals from the godown for consumption or movement should be in the order of receipt, except in the case of moist or infested grain, which should have precedence over sound stocks.

5. Before an empty godown is taken for storage, it should be thoroughly cleaned and all cracks and crevices in the floor and walls filled up. It is also useful to lightly dust on the walls and floor some DDT. or BHC. preparation.

6. Gunnies, particularly those used for grain-storage previously should be free from insects. It is desirable to dry them thoroughly in the sun before putting grain into them again.

7. All sweepings and spillages should be carefully collected and put in bags kept for this purpose. They should not be swept into corners as such small heaps serve as breeding places for insects.

8. Only sound grain, *i.e.*, grain free from insects (A category) such as freshly harvested grain should normally go into storage. As a preventive measure against insects from other sources penetrating into it, each stack should be lightly dusted all over with a suitable BHC. or DDT. formulation. This dusting is to be renewed once a month.

9. If slightly infested grain (B category) is to be taken into storage, it should be kept apart from 'A' category grain and dusted immediately on arrival. If more highly infested grain (C and D categories) comes in, it should be fumigated, *i.e.*, enclosed in a gas-proof tent or air-tight room with a measured quantity of fumigant, like 'Killoptera' introduced inside. The fumigant volatalises quickly into a gas which kills all life in the grain under treatment.

10. Since *status quo* is rarely maintained for a long time in regard to insect-infestation, it is advisable to examine the condition of the stock at regular intervals and to take appropriate steps to control the infestation along lines indicated above.

11. *Rat-proofing.*—While it is difficult to prevent the entry of rats into buildings used for ad hoc storage purposes, certain rat-proofing devices can be easily incorporated into godowns and granaries under construction. Among essential improvements to keep out rats from storage premises the following may be mentioned here :—(1) A pucca floor of cement or stone-slabs (2) close-fitting doors (3) pucca window-shutters to be carefully closed at nights (4) the space, if any, between the top of the wall and roof to be blocked with cement and (5) mouths of drain-pipes, if any, to be closed with "wire mesh." A simple method of preventing rats from gnawing a hole at the bottom of the door where the two shutters meet is to nail a narrow tin-strip at the lower edge of the moving shutter in such a way that the lower half of this strip hangs loose and can be tucked under the door when it is shut.

Other methods of rat control are (1) Baiting, *i.e.*, providing poisoned food and (2) trapping or attracting rats to mechanical contrivances where they meet with death or imprisonment.

12. The effect of excess moisture in the grain leading to fungal and bacterial attack can be largely overcome by proper aeration in general, and by spreading out such grain, in thin layers in the sun or inside the godown during the rainy season.

The principles briefly enunciated above call for great vigilance and prompt action along certain lines. The procedure suggested here, no doubt, involves certain labour and effort incidental to the commodity and the enemies from which it is to be protected. But whatever the labour and effort the attempt is worthwhile since if 'to grow two blades where there was one' is the inspiring motto for Agriculture, it is equally important to conserve and protect the Fruits of Agriculture.

THE ROLE OF INSECT PREDATORS IN PLANT PROTECTION

By Dr. M. Puttarudriah, B.Sc. (Hons.), M.Sc., Ph.D.
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The employment of insect parasites and predators (natural enemies) for the control of animal and plant pests is what comprises the biological method of control. It is nature's own method of control. Once the natural enemies are established they spread by themselves and maintain almost indefinitely. It does not endanger human health as insecticides often do; nor does it involve the problem of insecticidal residues or the breeding of resistant strains of pests.

In this paper it is intended to emphasize the importance of insect predators only in the control of crop pest. Among the various groups of insect predators certain beetles (*e.g.* Coccinellids) are well known to be of great economic importance, since the vast mojority of them (excluding the sub-family Epilachninae) are predacious on injurious insects like aphids, coccids, aleyrodids, mites, etc., on a variety of cultivated plants. They are voracious feeders devouring thousands of hosts every day; *e.g. Cryptolaemus* larva on an average is known to eat 1325 eggs of the citrus mealybug; *Chilomenes* larva requires about 200 aphids a day. The larva of the giant ladybird beetle, *Caria dilatata* of China has been reported to consume 400-500 bamboo aphids daily. The larva of *Chilocorus nigritus* F, is known to feed on 150 scale insects during its life. Numerous such examples can be cited. The value of these coccinellids in the biological control of insect and mite pests is all the more enhanced by the fact that both the adults and larvae feed on injurious insects and contribute towards the destruction of pests, as against parasites in which case the adult rarely takes part in the direct destruction of the pest concerned

Not much attention has been paid to the study of this group of beneficial insects in India. Beneficial coccinnellid beetles are being studied in the Division of Entomology, Mysore State Department of Agriculture, to survey the natural incidence of the various (predatory) ladybird beetles and to assess their value in controlling different insect pests (particularly aphids and coccids) and mite; to study their biology and to investigate the possibilites of mass-rearing of those that show indications of successful utilisation in the control of pests.

About 35 beneficial beetles (Coccinellids) have been so far selected and identified, and the following are being studied in detail.

Cryptolaemus montrouzieri **Muls**

This predator which was imported into California in 1892, and later into Hawaii, Java, Egypt and other countries from Australia its native home, was for the first time found in India around Bangalore in 1951, feeding on

Araucaria scales, *Eriococcus araucaria* Mask., and the several species of mealybugs infesting guava, mango, mulberry, brinjal, and a number of orchard and ornamental plants. It is fairly well established here and is found to exercise an effective check on the several mealybugs. It is active throughout the year and is found in all its stages on the scale-infested Araucaria pines and the various mealybug infested plants, though less abundant during summer months.

Its biology and bionomics under Mysore conditions were studied. It is easily reared in the laboratory. The entire life cycle from egg to adult takes about 23-35 days. Both larva and adults feed on the eggs and young ones of the mealybugs.

Small consignments of the predator were sent to Madras and Coorg States at the request of the Government Entomologist and Agricultural officer respectively for colonisation, though later it was found that Madras collections of insects at Coimbatore included this predator without knowing it taxanomy and importance.

Several species of *Pullus*, *Scymnus*, *Nephus* and *Stethorus*, have been collected and got identified. They are found to be very useful in reducing the populations of aphids, mealybugs and mites in nature, on groundnut, brinjal, cotton, guava, mango, mulberry, *Thevitia*, cowpea, citrus, jowar, castor, pumpkin, garden-pea, cucumber and many other economic crops.

Giant ladybird beetles

Synonycha grandis Thumb, *Anisolemnia dilatata* Fabr.—As the name indicates they are very big predatory coccinellid beetles capable of destroying a large number of aphids. *S. grandis* has been known as one of the most important natural enemies of the sugarcane aphid, *Oregma lanigera* Zehnt. This predator together with the smaller giant beetle, *A. dilatata* were found round about Bangalore feeding on the bamboo woolly aphid, *O. bambusicola* Takahashi. They were found in all their stages abundantly during the period, July to December, which synchronises with the incidence of the aphid in nature. The smaller giant beetle is more commonly found feeding on the bamboo leaf aphid, *O. bambusae* Buckt. (= *mysorensis* Theobald). Both the grubs and adults of the two predator beetles are voracious feeders and wipe out heavy infestations of the woolly aphid on bamboo bushes within a short period.

The two predators resemble each other very closely, in seasonal occurrence, feeding habits and life history in general.

In addition to their natural host-aphids, two predators have been found to feed and complete their development in the laboratory on aphids infesting groundnut, cotton, cowpea, pea, rose, jack, brinjal, cabbage, radish, citrus, sorghum and other vegetable and orchard crops. The life cycle from egg to adult occupies 18 to 27 days. In captivity they exhibit cannibalistic tendencies, the beetles feeding on their own eggs, and older grubs feeding on younger ones, when there is scarcity of natural food.

Chilomenes sexmaculata **Fabr**

This is a very common and widely distributed coccinellid in India. Many colour variations of the beetle are met with, so that they are mistaken for different species. It is active throughout the year and feeds on a number of species of aphids, and occasionally on mealybugs of the genera *Pulvinaria*,

and *Pseudococus*. It has been observed to increase in number and exercise an effective check on groundnut aphid round about Davangere. Both the grubs and adults are voracious feeders.

Coccinella septumpunctata **L**

This is another commonly found ladybird predator feeding on mustard aphis. It is active during the months of July-November, particularly abundant in September and October. Both the grubs and adults contribute greatly in reducing heavy infestations of mustard aphids. It is also known to feed on aphids on cotton, wheat, sorghum, etc.

Its life history was worked out in detail. It has very short life cycle, of 13-22 days ; thus a large number of generations are possible in a short period. The adults live fairly long and in the laboratory can be easily reared on aphids infesting pea, cowpea, cotton, cabbage, radish, etc.

Coccinella repanda **Thunb. var.** *transversalis* **Fabr**

This is usually seen with *C. septumpunctata*, but its preferred host is lucerne aphid. It has also been observed as feeding on aphids infesting groundnut, pea, cotton, cabbage, wheat, sorghum, watermelon, etc. It is a widely distributed species in South India, East China, and Australia.

Several other coccinellids of the genera *Coccinella*, *Coelophora*, *Verania*, *Propylea*, *Illeis*, *Brumus*, etc., have been noted as usuful natural agencies in checking aphid pests on many economic crops.

Chilocorus nigritus **Fabr**

This predator has been found feeding on greenbugs on coffee, and a number of hard scales infesting apple, citrus and some ornamental plants.

Its life history occupies 3-4 weeks, and the adults live long, the longevity being 45-60 days. Both the adults and grubs are good feeders. They lift up the covering of the hard scales and feed on the soft insect inside. Small scale field liberations against greenbugs infesting guava, have given encouraging results.

Rodolia cardinalis **Muls**

This imported predator from California has established itself here, and along with a few local species of *Rodolia* is found to have checked greatly, the spread of fluted scale in casuarina groves.

BIOLOGICAL CONTROL OF INSECT PESTS

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The control of insect pests by parasites has been receiving the attention of entomologists all over the world for several decades. The progress achieved by this method, though spectacular in certain instances, is generally rather

slow because the success of this method is dependant on several factors, such as climatic conditions, availability of host, adaptability and spread of the parasite in the new environment.

In Mysore, work in this method of control of insect pests and weeds was initiated in 1927. But a regular study of the behaviour and bionomics of the several indigenous parasites was taken up since the past few years. This note is a brief review of work done in the field of biological control (parasites only) of insect pests in Mysore.

Sugarcane Stem Borer and its parasites

The possibilities of the control of the sugarcane stem borer—*Chilotraea infuscetella* Snellen,—by the egg parasite—*Trichogramma minutum* R.—was investigated as early as 1930. *Corcyra cephalonica* St.,—popularly called the 'Rice and Flour Moth' which is a common store pest of jowar, rice and flour, was found very well suited to serve as the laboratory host for mass-rearing of T. *minutum*. The eggs of the rice moth are used to breed the parasite in the laboratory in large numbers for further release into sugarcane fields when the crop is between 6 to 10 weeks old. The initial parasite material was obtained from a sugarcane field at Madivala near (about 5 miles) Bangalore. Preliminary observations regarding the behaviour and other relevant factors about the bionomics of the parasite and the laboratory host were made first in the laboratory at Bangalore and subsequently at the Parasite Laboratory, Mandya.

With the establishing of the sugar factory at Mandya in 1933, the area under cane in this area gradually increased in extent and sugarcane was grown throughout the year, the planting of cane extending to even 10 months. This resulted in the increase of the attack by this insect resulting in a greater percentage of 'dead-hearts' appearing in young sugarcane areas. A laboratory to breed this tiny parasite in large numbers was established in the year 1934-35. The Mysore Sugar Company co-operated with the Department and extended help by way of small money grants and equipment. This laboratory has been engaging itself, from its inception to date in the production and field releases of T. *minutum*, with an appreciable measure of success.

The production unit being small, it was not possible to meet the requirements of all the sugarcane growers and thus the laboratory-bred parasites were being released mostly in the sugar factory farms, and Visweswariah Canal Farm. Last year the Government of Mysore were pleased to sanction a scheme for control of sugarcane borers financed by the Sugar Cess Fund, and it is proposed to enlarge the production unit to cover at least 5,000 acres per year at the end of three years.

Side by side with the routine releases of the parasite into sugarcane fields, further studies (1) to increase the output of *Corcyra* moths with the use of different food media; (2) to increase the percentage of parasitisation and thereby increase the output of the parasite have been made. Improvement over the present method of mechanical (hand) collection of *Corcyra* moths in the mass rearing unit by means of automatic collection by suction from standardised breeding chambers into special type of contrivances has been tried with initial success. Further work is in progress to standardise this contrivance. The parasite laboratory for production of T. *minutum* at Mandya has been a pioneering venture which has given satisfactory results, and has set an example for other States to follow suit in this method of control of the sugarcane stem borer. This laboratory has not only supplied parasite material for

places outside Mysore State in India but also has served as a training centre in the mass production of *T. minutum.*, for entomologists who were deputed from other parts of India.

Sugarcane Top Borer and its parasites

The sugarcane top borer—*Scirpophaga nivella* W.,—is the other common and serious pest on sugarcane. The caterpillar attacks sugarcane of 3 months in age or older causing a stunted growth and ' bunchy top '.

This insect is subject to the attack of parasites in its egg, larval and pupal stages of development. Of these, the three egg-parasites *Tetrastichus scirpophagae*, *Phanurus beneficiens* Zehn and *Trichogramma minutum* are the most important. Detailed observations in the field have revealed that T. *minutum* plays a very insignificant part in the parasitisation of the eggmasses of the sugarcane top borer. The percentage of parasitisation of the eggmasses has been found to vary between 57 and 76, though heavier incidence of parasites has been noticed during certain months. With the limited success attained in breeding these parasites on suitable laboratory hosts, the other method of conserving the emerging parasites from field collections and releasing them into the field was adopted during the years 1936—43. A specially designed container was built to put in the eggmasses collected in the field and to collect the emerged parasites. In fact, the Government subsidised certain amounts for this work in the initial years for educating the cultivators in the usefulness of this method of control. This method not only reduced the incidence of borers in the field (in that the emerging larvae were trapped in the container and later destroyed) but also augmented the activities of the parasite in the field.

The biology of the three larval parasites—*Rhachonotus scirpophagae*, *Elasmus Zehntneri*, *Ferr.* and *Stenobracon desae* cam, have been studied and their natural multiplication in the sugarcane areas are being watched for further investigation.

Another small chalcid parasite—*Tetrastichus ayyari* Rohw., collected from the pupa of *Chilozonellus* on jola has been found to breed in the laboratory on the pupae of several hosts including those of the sugarcane stem and top borers. The bionomics of this parasite have been studied. The utilisation of this parasite against the sugarcane borers with a view to maintain continuity or sequence of parasites in the egg, larval and pupal stages of the borers are being investigated.

Sugarcane Mealy Bug and its parasites

Sugarcane mealy bug—*Sacharicoccus sacchari* Ckll—though found in sugarcane areas has not assumed the form of a serious pest in Mysore. It is found in larger numbers in summer and drought months than in the monsoon months. Three parasites including *Anagyrus saccharicola* Timberlake, have been obtained from the field collections. The field incidence of the parasite is being studied and the present studies made so far indicate the percentage of parasitisation to range between 31.5 and 57. The parasites along with the predators seem to exert a control over the spread of the insect. The bionomics of the parasites and the host are being studied to investigate the possibilities of augmenting the existing biological control in nature.

Paddy Stem Borer and its egg parasites

Of the three parasites, *Tetrastichus schoenobi* Ferr. is found to be the most common and effective parasite of the paddy stem borer—*Schoenobius*

incertellus W., The parasite has been bred in the laboratory on the eggs of the sugarcane top borer and thereby has increased the importance of this parasite. Further observation on the method of mass multiplying and utilisation of this parasite are in progress.

Field Crop Pests and *Microbracon hebetor*, Say

Microbracon hebetor Say, is the natural larval parasite of *Corcyra cephalonica* St. The utilisation of this parasite against certain insect pests of economic crops has been investigated. The method of breeding this parasite in large numbers in the laboratory on the host—C. *cephalonica* St., larvae—has been standardised and a special breeding chamber for mass multiplication of the parasite has been devised. This parasite has been observed to parasitise, the *Avare* pod-borer, *Adisura atkinsoni* M., the Ragi stem borer—*Sesamia inferens*, W., and the Jola earhead webbing caterpillar, *Stenachroia elongella* H. Large scale field trials have been conducted utilising this parasite against the lablab (*Avare*) pod-borer—A. *atkinsoni*, M. This parasite plays its part without interfering with the activities of the natural parasite. Parasites have been recovered from infested pods collected in the fields where this parasite was relased in numbers. It is observed that the parasite attacks only half to full grown larvae thus allowing the younger stages of the larvae to continue to do the damage till they grow to a stage when they become suitable for being attacked by the parasite. Nevertheless it can be said that this parasite reduces the intensity of attack and also the number of the progeny, a decided advantage, which, when practiced over several years continuously will yield favourable results.

Potato Epilachna Beetle and its parasites

The small black shining chalcidoid wasp, *Pleurotropis foveolatus*, C.,—is a natural parasite of the larva and rarely pupa of the Epilachna beetle—*Epilachna-viginti-octopunctata*—a serious field pest of potato and brinjal. It occurs in nature in fairly high numbers, the percentage of parasitisation in certain months being as high as 72. The incidence varies from month to month. It is also seen that there is not a uniform distribution of the parasite in nature resulting in the parasite being found congregated only in certain areas. The bionomics and habits of the parasite have been studied. A cheap box-like contrivance to breed this parasite on its natural host has been evolved. It is a small rectangular wooden box with a tight-fitting sliding lid in the centre of which is a circular hole with an inverted cone fixed to it. Around and below the cone is fixed a screw lid to take in the neck of a bottle. Parasites along with healthy and parasitised grubs are put into the box and the lid is covered. The emerging parasites collect in the bottle, being attracted to light, and these parasites are taken to infested potato fields, where the parasite number is poor, and released. Such healthy and parasitised grubs are put into the box periodically and a continuous supply of parasites is maintained. These releases increase the colonisation of the parasite and minimise attack by the pest. Field trials have given encouraging results. The effect of increased colonisation of the parasite by release of parasites into infected potato fields in relation to the yield of the crop is being investigated.

The Egg Parasite

The egg of the epilachna beetle is subject to the attack by a tiny black wasp—*Tetrastichus ovulorum*, Ferr. The bionomics and habits of this parasite have been studied The field incidence of the parasite is about 42% in particular months. Trials to breed this parasite on any other suitable laboratory host for field releases are being investigated.

SOME INSECTICIDES FOR COMMON USE BY THE AGRICULTURIST IN PLANT PROTECTION WORK

By Dr. M. Puttarudriah
Joint Entomologist

Insect pest control methods are of five kinds in general, *viz.* mechanical, cultural, chemical, biological and legislative. Of these, the chemical method is both preventive and curative. It consists of the use of insecticides which kill the insects at varying lengths of time. It convinces the cultivator, as he can see the dead insects, and the use of insecticides is a necessity under a crisis. They act as contact and stomach poisons, as fumigants and repellents.

The following are the common insecticides which have been tested and found useful in the control of insect pests. They are being recommended for use by the cultivators.

Vegetable insecticides

Honge oil resin soap.—This is a vegetable insecticide developed from researches in the Division of Entomology, Mysore Department of Agriculture, to replace the fish oil resin soap which was being imported in large quantities from Calicut. The Government Soap Factory at Bangalore are the manufacturers of this product at the instance of the Department of Agriculture; and large quantities of it are being manufactured every year and sold to the cultivators. The cost used to be very low, but now due to the high price of the ingredients it sells at nine annas a pound. It has been found to be effective on several sucking insects, and is a good contact insecticide, being commonly used by many cultivators against plant lice—aphis, and mealybugs. The soap must be kept airtight as it loses its efficacy on exposure and age.

On aphis and thrips it is effective at a strength of 1 lb. in 8-10 gallons of water, with a through drenching spray on all parts of the plant, particularly under surface of leaves.

On mealybugs and greenbugs a stronger dosage is necessary, at 1 lb. in 4 gallons of water.

Tobacco decoction: is another effective contact insecticide in place of nicotine sulphate. It is easily prepared from tobacco waste.

One pound of dry tobacco (refuse stems, leaves, and powder found in tobacco shops) is steeped in one gallon of water for 24 hours or boiled for half an hour and then strained. 4 ozs. of ordinary soap sliced and dissolved separately, is added to the tobacco decoction and the mixture is diluted to 6-7 times by adding water.

This decoction may be prepared afresh and used in spraying against aphis, thrips and other sucking insects.

Kerosene extract of pyrethrum

One pound of pyrethrum powder is soaked in one gallon of kerosene oil for 24 hours and filtered. A little lemongrass oil or any other essence is added which will mask the kerosene smell, and is used in spraying against mosquitoes, eyeflies, etc. The extract may be emulsified by adding soap as is done in the preparation of kerosene emulsion. This emulsion is effective on hairy caterpillars of cardamom, etc.

Chemical insecticides

Kerosene emulsion, is also a good contact insecticide. The ingredients are mixed in the proportion of 1 lb. of ordinary soap with one gallon of water and 2 gallons of kerosene oil.

The soap has to be sliced and boiled in water separately till it is dissolved. It is taken off the fire. Then the oil is added in small quantities and beaten, till it emulsifies. Then it is cooled slowly by beating.

It is particularly useful against cattle ticks.

Calcium arsenate mixture is a very common stomach poison used against many biting insects. It is being very popularly sprayed against Epilachna beetle on potatoes in the State. Calcium arsenate has replaced lead aresenate as the latter is not easily available, in the preparation of this mixture, It is prepared afresh every time and takes 4 days to effect mortality.

Ingredients : 1 lb. of calcium arsenate.
2 lbs. of lime.
3 lbs. of jaggery.
50 gallons of water.

Preparation : Dissolve powder lime in a little water and strain. Then add calcium arsenate into the lime water and mix the two.

Dissolve jaggery in a little water separately and strain. Then mix it with the lime and calcium arsenate mixture in little quantities and stir. This stock solution is added to the remaining quantity of water and stirred up, and used for spraying.

Warning : Since calcium or lead arsenate is a deadly poison, the workers must be careful while handling it. The mixture must be stirred with wooden stick : the vessels used in the preparation must be thoroughly washed after and hands must be washed well. The village workers handling it must be warned against chewing betel leaves, etc., without washing their hands. Cattle, goats and other animals must not be allowed to graze on the sprayed plants for 4-5 days.

Poison bait for grasshoppers and cut worms, etc.

Formula I		*Formula II*	
Bran	50 seers	Bran	50 seers
Sodium silicofluoride	1 seer	Sodium silicofluoride	1 seer
Molasses	2 seers	Salt	1 seer
Water as required		Water as required	

Amyl acetate may be added to either mixture at the rate of one *chatak* for 50 *seers*, if this material is available. It is not considered essential, but it does attract grasshoppers to the bait.

Preparation : Bran and sodium silicofluoride should be mixed in a dry state by hand or in a rotating box. The molasses or *gur* dissolved in minimum of water is added to the mixture. Further water is added until the bait becomes moist and crumbly, but not so wet as to be sticky and adhere in lumps.

The bait is scattered all over the field early in the mornings for grasshoppers, and in the evenings around bases of plants for cutworms.

The bait must be moist aud fresh for good results. It has been found to be effective against cutworms in several places in the State.

Workers must wash their hands after use, as sodium silicofluoride is a poison. In the absence of sodium silicofluoride any other chemical like calcium arsenate or lead arsenate or Gammexane may be used.

Lime-Sulphur mixture

Formula: 10 lbs. of sulphur finely powdered.
5 lbs. of lime.
5 gallons of water.

Lime is slaked in one gallon of water in a tin or drum. When slaking has begun, the sulphur is added. Then add 5 gallons and one gallon extra, of water so that when boilng, the extra quantity of water is evaporated. Further extra water may be added to allow for evaporation so that the quantity always remains to be 5 gallons. When boiling it should never go down 5 gallons mark. The ultimate stock solution should also be 5 gallons.

Boiling may commence after one hour and the boiling should continue for one hour, throughout accompanied by stirring with a wooden rod. It is then taken down, cooled for one hour, strained through cloth or filter paper and preserved in airtight vessels. The liquid will be amber coloured and clear, and is further diluted to the required strength when spraying.

It is used in spraying against several species of mites on citrus and other plants.

Sulphur

Fine sulphur powder is a good acaricide when used in sunny wheather.

Mango Fruit Fly Bait

Sodium silicofluoride	...	2 ozs.
Sugar (may be inferior type)	...	2 lbs.
Water	...	4 gallons.

Small quantities may be prepared by mixing the ingredients in the above proportion. The liquid bait is exposed in cigarette tins with cotton wicks one end of which is immersed in the liquid, the other end being drawn out on a bent flap of the edge of the tin. For making the flaps, 6 cuts of one inch deep are made on the edge of the tin and the pieces bent outside. A drop of citronella oil mixed with the bait will attract the flies. They suck the poisoned liquid and die somewhere.

The bait can also be sprinkled on the foliage for the flies to suck on the droplets.

Ant Baits

Formula: (*a*)

Sugar	...	1¼ lb.
Water	...	1¼ pints
Tartaric acid crystals	...	1 gram.
Benzoate of soda	...	1 gram.

Mix the above and boil for half an hour.

(*b*) Dissolve ⅛ oz. of sodium arsenate in one ounce of hot water,

When (*a*) and (*b*) are cool they are mixed and stirred ; ¾ lb. of honey is mixed. Small bits of sponge are soaked in the bait and placed in ant haunts, in covered vessels with small holes for the ants to enter, and feed on the bait.

Zinc phosphide

It is used in rat baits. Any eatables like potato chips, fried fish, grains and flours, etc. are mixed with zinc phosphide and exposed in rat haunts.

Many proprietary raticides are on the market.

Zelio grains can be readily used in scattering a few grains in places where rats frequent.

Muritan is another product which can be used in place of zinc phosphide for making baits.

Rats are very suspicious and baitshy. If poisoned uncommon foods are used in places where they are accustomed for certain grains or particular food material, the same food material must be used for making the bait, or they must be trained to eat the new food materials by using non-poisoned food material for 3-4 days before putting the poison bait.

Cyanogas dust

It is used in fumigating rat burrows, by forcing the dust into the burrows by the pump and then closing the hole.

Modern Insecticides

Since the second world war, many synthetic organic compounds with insecticidal properties have been developed ; and they are fast replacing many of the older insecticides. The following are the more popular ones.

BHC. Products.—Benzene hexachloride with the effective gamma isomer is being sold under several trade names, like Gammexane, 666, Hexyclan, Hexidole. Hexamar, Klorotex, Benoxide, Benzaxine, Hexachlor Cyclohexane, Agrocide, etc. These products are obtainable in different strengths, and are popularly used in dusting against grasshopper nymphs, plant bugs, cotton pests, castor semiloopers, cutworms, termites and against store pests. Agrocide is wettable Gammexane used in spraying.

DDT. was the first modern synthetic insecticide, and is very popular as a mosquito larvicide, and also on mosquitoes and houseflies though resistant strains are fast building up. DDT. 10%. is effective on several caterpillars. DDT. 50% wettable powder, when sprayed at the rate of 1 lb. in 16-20 gallons of water has been found to be very effective against mangohoppers.

There are other phosphatic compounds and pyrenone insecticides which are being tested and are likely to become popular.

Killoptera

It is a mixture of Ethylene dichloride and Carbon tetrachloride. It is an effective fumigant against store pests, when exposed in airtight receptacles containing the infected materials. It is used at the rate of 30 lbs. per 1,000 cubic feet.

INSECT ENEMIES IN A FLOWER GARDEN

By Dr. M. Puttarudriah
Joint Entomologist

The flower plants are subject to several insect pests which infect every part and cause many types of injuries. These insect pests can be put under two categories—sucking and chewing, the latter including leaf mining, stem tunnelling, and gall forming. The sucking insects attack leaves, tips flowers, stems and roots.

By sucking injury the parts of the plants—leaves, flowers and stems, etc. get twisted and curled up, as the insects suck the sap from these parts. Thus these parts do not develop and though the plants are not immediately killed, they look ugly and soon die.

The chewing insects bite and skeletonize leaves, cut the bases of stems bore into stems and attack the root system, too.

The sucking insects can be killed by contact insecticides, used in the form of spray or dust; where as the biting insects require a stomach poison and take some time to die; but they can also be controlled by powerful contact insecticides, which are used as in the case of sucking insects, in the form of sprays, dusts and baits.

In this paper it is proposed to indicate the several types of insects, the nature of damage and control measures.

Sucking insects

Among sucking insect pests, plant lice, scale insects, mealy bugs leafhoppers and plant bugs are important. Aphids or plant lice infect all kinds of plants and all parts of plants. They occur in colonies at the tender parts and underneath the leaves. They suck the sap of the plants and make them curled up, distorted and malformed. Ants are their associates always found with them for eating the sweet sticky excreta called honeydew of the lice. The honeydew also attracts wasps, flies and other insects. Ants even carry the lice from place to place and thus spread them to other plants. Sooty mould grows on the sticky substance, making the plants ugly and further deteriorate. Aphids are of several kinds and colours. They attack Asters, Iris, Crocus; and carry Carnation mosaic, Lily mottle virus, Pansy and Viola flower breaking, and mosaic diseases of gladiolus and other plants.

To control: Spray Honge oil resin soap (fresh matrerial) at the rate of 1 lb. in 6-8 gallons of water. A drenching spray at frequent intervals is necessary, as some lice are sure to escape and build up quickly. This material is available in Government Soap Factory, Bangalore.

Tobacco decoction is a good alternative for honge oil soap spray. It is prepared by soaking one lb. of waste tobacco in one gallon of water for 24 hours or boiled for half an hour; and then filtered. To the decoction ordinary soap dissolved in water is added at the rate of 2 ozs. per lb. The mixture is diluted 6 to 7 times for spraying.

The scale insects comprise hard scales, which are round, covered with a shell above. The mealybugs can be easily detected by the presence of white cottony ovisacs partly convering on them, in which eggs are found. The

young ones of both the scales and mealybugs are called crawlers; they are small, yellowish, active and spread quickly to all parts of the plants. They grow by sucking the sap of the plants and settle down after sometime permanently in one place. Colonies of these scales can be found infesting Crotons, Allamonda, Thevitia, Pittosporum, Plumbago, Azalea, Camellia, Hydrangea, Guava, Mango, Citrus and many other horticultural and fruit plants.

The important scales are *Aspidiotus* spp. *Eriococcus* spp, the soft brown scale and the black scale, etc.

Treatment: Scale insects and mealybugs are hard to kill because of the shell and mealy covering through which the insecticide cannot penetrate easily. Oil emulsion sprays are better in their effect on these insects. Kerosene oil emulsion can be easily prepared and used at frequent intervals, so that the crawlers are killed as and when they emerge and are active. A drenching spray with Honge oil resin, or Fish oil resin soap at the rate of one lb. in 4 gallons of water will also give good results against the crawlers.

Several kinds of mites popularly called, "red spiders" which are not true insects but Arachnids are a serious pest of ornamental plants. They suck the sap from the leaves and other tender parts, which result in the stripping of parts with pale brown colour. A thorough dusting of fine sulphur powder will give a fairly good control of this pest.

Thrips are tiny insects with feather-like wings. They attack several horticultural plants, the foliage, buds, flowers and bulbs, etc., being damaged. The gladiolus thrips is an outstanding example. The infected parts become russetted and foliage curled up. Thrips also are vectors of virus diseases.

DDT. spray or dust gives a good control of thrips. Toxaphene Chlordane and Parathion are latest insecticides that are effective against thrips. A good spray with Honge oil resin or Fish oil resin soap; or Tobacco decoction will also control this pest.

Leafhoppers are slender, usually brown to green, delicate insects attacking Asters, Calendula, Dahlia, Gladiolus, Hollyhock, Marigold, Rose, Zinnia, etc.

DDT. dust or spray will control this insect.

Lacebugs can be easily recognised by their lacelike thin shining wings which lie flat on their oval bodies. The young ones are also small and shiny. Both the adults and nymphs suck the sap from the foliage. They are found on the lower surface of the leaves. This injury causes the mottled discolouration of the leaves. On the lower surface may be found specks or excreta of the bugs. They attack Azalea, Chrysanthemum, Rhododendron, etc. They can be easily controlled by nicotine sulphate or pyrethrum sprays. Wettable DDT. 50%, 1 lb. in 16 gallons of water may also be sprayed.

Psyllids are small, greyish-green sucking insects allied to plant lice. The nature of injury is exactly similar to that of aphids resulting in curled tips. The young ones of this bug are covered with white waxy powder.

A drenching spray with wettable DDT. 50%, 1 lb. in 16 gallons of water will control this insect. Spraying with tobacco decoction or Honge oil resin soap 1 lb. in 6-8 gallons of water will also be helpful.

NO RAIN AFTER *Kartik*; NO WAR AFTER THE DEATH OF *Karna* (IN MAHABHARATHA).

Chewing insects

Chewing insects, as the name indicates defoliate the leaves by biting ar tunnelling into the stems. Many kinds of chewing insects are met wit on the plants. Caterpillars, beetles, weevils and sawflies are the mo important.

Caterpillars are of many kinds. They bite the leaves and other par of the plants and also mine into the leaves. Bagworm caterpillars are easi noticed by their peculiar habit. The caterpillar lives in a bag made up of bi of leaves and sticks. The bags are of various shapes,—pyramids, cones, et At one end they are opened. The caterpillar moves with its head end outsid through the opening, the rest of the body being covered by the bag. The bite holes on the leaves and if the bagworms are too many, the plan suffer badly.

Since the caterpillar lives inside the bags, no contact poisons w control them. A stomach poison is necessary to kill them. Calcium or lea arsenate spray as is done for Epilachna beetle on potato will kill them As the bags are easily seen they can be handpicked with the caterpillars *i situ*, and destroyed.

Cutworms are smooth, plumpy, black or brown caterpillars. When ful grown, they measure an inch or two. They are seldom seen during daytim as they hide under clods or below the top soil. A little scratch of the soil c removal of clods around bases of plants will reveal them. They are nocturn in habit ; and after dusk they come out and cut the young plants at groun level, and also climb up and feed on the leaves and bore into flower buds.

The cutworms are a serious manace on several vegetable and field crop In recent years they have assumed the pest status and destroy the plants ove night. Several species of cutworms are met with ; and they are common o cabbage, chillies, potato, etc., vegetables, flower plants and also some fiel crops.

They are easily controlled by poison bait made up of one part of Sodiu silicofluoride mixed with 8-10 parts of wheat or rice bran and a little jagger dissolved in water. In place of Sodium silicofluoride, Calcium arsenate c Gammexane may be used. The bait must be wet and is scattered around th bases of plants in the evening. The caterpillars feed on the bait in the nigh and die. If they are seen on the foliage, 5% Gammexane powder may b dusted.

Hairy caterpillars commonly called "*Kamblihulas*" cause great damag to many kinds of plants, as they are polyphagous. They break out in winte months and can be seen crawling in large numbers. Since they are pol phagous they attack vegetable and field crops and also flower plants like jas mine, rose, etc.

These caterpillars can be easily controlled in their younger stages. Afte hatching they remain in clusters on underside of leaves feeding on the gree matter. Such leaves become skeletonised and can be easily made out. Suc leaves with the congregating caterpillars can be pinched off and put in kero sened water. After they are grown up, it is rather difficult to control them a they scatter in all directions. A stomach poison spray or dusting of Gam mexane will help.

Sawfly larvae are black and are very similar to caterpillar They bite holes on roses, radish, cabbage, mustard, etc. plants. The

re false caterpillars, being young ones of a Hymenopterous wasplike nsect.

For control, dusting of 5% Gammexane powder may be adopted.

The rose chafer is the most common insect enemy of the leaves and petals f Rose, Iris, Peony and many other flower plants. They are active after dusk nd bite holes one leaves and petals. They are moderate sized brown beetles. stomach poison spray like the calcium arsenate mixture is necessary to kill nem.

The leaf mining insects cause blotches or serpentine tunnels by feeding n the green matter between the two surfaces of leaves. The damaged ortion appears as white patches and tunnels. The blotches are seen on rborvitae, burdock, and boxwood leaves and the serpentine tunnels on olumbine and holly leaves, citrus leaves, etc. The damage if extensive leads o the disfiguration and death of plants.

Badly damaged leaves must be removed and destroyed ; then a spray with DDT. 50% wettable powder will be of some help.

Gall forming insects sting the cells and stimulate them to grow gall-like tructure of various sizes and shapes. The chrysanthemum gall midge, the illow gall midge, etc., are very common The chrysanthemum gall is caused v an orange-coloured small fly maggot. The galls are cone shaped, formed s a result of irritation of the cells by the maggot. The plant becomes dwarfed, nd flowers are not borne upright.

DDT. 50% wettable powder spray will give effective control.

Among the borers, there are several species of caterpillars, beetle grubs, hich tunnel through the stems. Many flower plants like the Aster, Cosmos, Dahlia, Delphinium, Hollyhock, Lily, Peony, Phlox, Zinnia, etc., are attacked y borers. The damage is not easily detected until the plants wilt or droop. A mall hole may be seen on the stem at the point of entrance of the catterpillar. f the stem is split, a tiny caterpillar or grub may be seen.

Borers are difficult to control, when once they are inside the stems. A reventive spray or dust is necessary to prevent the moths from egglaying. If he stem is thick enough and the holes are seen, injection of pyrethrum extract r DDT. solution by a small syringe will help in killing the insect inside the tem.

Ants are often injurious to flowers plants. They burrow at the base of lants for making nests, thus exposing the plants to drying. They are also esponsible for the spread of aphis, mealybugs and some scale insects which roduce honeydew.

The nests may be dug out and the brood of the ants destroyed. Chlordane may be used as a wettable powder, for controlling them. The olution may be poured into the nests and closed. If they are found in ssociation with honeydew producing insects, the latter must be destroyed y a good contact insecticide.

Termites often attack living plants. They are subterranean in habit and amage the plants by hollowing them. They live in colonies, normally eeding on dead and drying plant materials. Clean cultivation is very ecessary. The nest must be dug out and the brood destroyed. Chlordane r wettable Gammexane solution may be used for drenching the ground and or pouring into the nests.

Snails and slugs, and millipedes cause some trouble to the flower plant particularly in damp and shaded places. The leaves and stems and tende roots are attacked. Poison baits may be used for controlling them. DDT Toxaphene or Chlordane may be used as dusts or sprays.

The above, are a few examples of insect enemies; and it is very necessar to control them for successful cultivation of flower plants and othe horticultural plants.

PESTS OF PADDY

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I. THE PADDY STEM BORER

The Paddy stem borer, *Schoenobius incertellus* Walker (Lepidoptera Pyralidae), is a major pest found in almost all tropical and sub-tropica regions. It is specific to paddy and occurs over the entire State.

Nature of Damage and Life-History.—The caterpillar is a borer feedir from inside the stem, which results in the gradual fading and death of t central shoot in a young plant (*Dead-heart*) and of the whole earhea in a mature plant (*white chaff earheads*). Eggs are laid in small masses o the tender leaf blades, the egg-mass being covered by a layer of soft a buff-coloured hairs derived from the anal tuft of the female moth. The egg sp'herical, cream white in colour, and hatches in 9—10 days. Young cate pi lar which hatches out from the egg crawls along the leaf blade or hang down by a silken string and and reaches the stem where it bites a hole near node and enters the stem. When full-fed the caterpillar is pale yellowis white, smooth and an inch in length. Pupation takes place inside the ste itself, often in the lower region, within a transparent silken cocoon. T adult moth emerges out through a hole previously made by the caterpill in the stem Female moth is bigger than the male and has bright yellowis forewings with a minute but distinct black dot on each of them. Male is a pale whitish yellow colour and the dots on the forewings are not clea The life-cycle is completed in about 1½ to 2 months. Egg: 9—10 day Larva: 28—35 days: Pupa: 10—12 days.

Control measures: Only preventive measures are possible.

1. Set up light traps to attract and kill adult moths before egg-layin during nursery stage, transplanting and before the earhead formation.

2. Select only healthy seedlings at the time of transplanting, rejectin "*dead-hearts*".

3. Collection of egg-masses and adult moths.

4. Removal and destruction of plant showing *dead-hearts* and whi chaffy earheads.

5. When possible, plough up and expose to strong sun or tramp upon the stubbles after harvest to destroy any larvae or pupae remaini in the stubble.

Parasites.—Telenomus beneficiens Nixon, *Tetrastichus schoenobii* Ferr. *and Trichogramma japonicum* Ashm are three natural egg-parasites, which occur in sufficient numbers during certain seasons, but they have not so far proved an effective controlling factor.

2. THE PADDY GRASSHOPPER

The Paddy grasshopper, *Hieroglyphus banian* Fabricius (Orthoptera: Acridiidae) is also a major pest of paddy, sometimes doing serious damage both in hopper and adult stages. It is highly localised and so far reported in a pest form from Shimoga and Mysore districts at irregular intervals, paddy, wild grasses and sugarcane are attacked.

Nature of Damage and Life-history.—The young hoppers (wingless) emerge soon after the first monsoon rains in June-July and grow by feeding on the grasses on the field bunds until the paddy comes up, by which time the adults (winged) are formed and begin to damage growing paddy by feeding on the leaves and shoots and cutting off of the earheads.

Eggs are laid in masses in cylindrical holes in grassy bunds usually between October—December. The eggs in clusters are firmly glued together. Each egg is elongate, elliptical of a yellowish colour. Egg stage lasts 8—10 months. Nymphs emerge after south-west monsoon rains. The newly hatched nymphs are white in colour, wingless and resemble the adults in general appearance. They are extremely active and cut the leaf blades. The adult is a green or yellowish-green winged grasshopper with irregular transverse markings on the dorsal and lateral parts of the prothorax. The lower surface is brownish black, while the tibia of the posterior leg is blue. The female is bigger in size and has 2 pairs of prominent ovipositors.

Control measures —In July-August as soon as young hoppers emerge, dust the field bunds with Gammexane or Hexyclan (5%); at a later stage dust the paddy fields with the same chemical (7% to 10). Dusting with this insecticide has completely replaced the older practice of trapping the hoppers with hopper dosers or the use of sodium silicofluoride baits.

3. THE PADDY CASE-WORM

The Paddy case-worm, *Nymphula depunctalis* Guenee (Lepidoptera: Pyralidae) is a somewhat serious pest of paddy, sometimes causing appreciable damage to young crop. It occurs over almost the entire State, and is popularly known as "*Kokkre roga.*"

Nature of Damage and Life-History.—The slender greenish caterpillars cut the paddy blades into short lengths, construct tubular cases, remain inside these rolls and feed on the green matter of leaves, which finally wither and dry up. Tiny, white eggs are laid on tender leaves Larvae are slender, pale green with an orange head, they fold and cut leaf blades, make tubular cases inside which they remain with head protruding outside, and move about dragging the case along. In badly infested fields a number of such cases are seen attached to plants; the leaves show eaten-up white patches and appear dull or drying and drooping. The caterpillars are semiaquatic in habit. Pupation takes place in a white cocoon inside the larval case. The moth is a small delicate insect with the wings creamy white and speckled with pale brown markings.

Control Measures.—(i) Kerosene oil treatment:—Close all the water out-lets and keep a cloth, well soaked in kerosene oil, in the inlets till a thin

film of oil is created on the standing water. Pass a long rope or pole briskly across the centre of the plants and dislodge all case worm bearing tubes hanging from paddy blades, to the surface of oiled water. Repeat the process till all the tubes are dislodged. The casse-worms are killed, when they come into contact with oil.

(2) In clear weather Gammexane or Hexyclan (5%) may be dusted in the affected plots to cover the plants with the dust.

4. THE SWARMING CATERPILLAR

The swarming caterpillar, *Spodoptera mauritia* Boisduval (Lepidoptera Noctuidae) is a minor pest of paddy all over the Mysore State. It appears suddenly in swarms of thousands, completely eats up a whole field and moves to another—hence it is also called the "*Army worm*."

Life-History.—Small spherical eggs are laid in batches of 200-300, and covered over by greyish hairs. Young caterpillar is green and escapes notice. Feeding on the green leaves, it grows in size, becomes smoothly cylindrical and is of a dark to pale green colour with dull dorsal stripes. The colour varies considerably. When touched the caterpillar curls up until the head and tail are nearly touching in a characteristic manner. The caterpillar feeds by night and hides by day under clods, etc., in the field. Pupation takes place in an earthen cocoon underground. Pupa is dark brown with 2 slender spines at its narrow apex. The adult is a stoutly built dark brown moth with irregular white markings.

Control Measures.—(i) Flooding of infested nurseries and small plots and sweeping and collection of caterpillars, which are then destroyed.

(2) Trenching of fields

(3) Dusting with Gammexane or calcium arsenate in fair weather.

(4) Spreading cooked rice, etc., in the field bunds to attract birds which attack the caterpillars

5. THE GREEN BEETLE OF PADDY

The Green Beetle of Paddy, *Leptispa pygmoaea* Baly (Coleoptera: Chrysomelidae), is a minor pest, confined to the *Malnad* Districts of Shimoga, Chikmagalur and Hassan. In 1946 it assumed the status of a serious pest and since then is continuing to attract attention.

Nature of Damage and Life-History.—The grub feeds on the green matter of the leaf, producing white patches; the tender leaves wither away and die. Similar damage is also done by the adults, but to a less extent.

Small cigar-shaped greyish yellow eggs are laid in batches (13 to 8) in a single row on the lower surface of the leaf. Larva is whitish grey in colour and is also found on the lower surface of the leaf. Pupation takes place in the larval mines; the pupa is yellow brown, without a cocoon. The adult is a small, narrow, elongate, smooth, bluish beetle, found on the under surface of the blades.

Control Measures.—Same as for the paddy case worm, namely, kerosene oil treatment or dusting with Gammexane or Hexyclan in fair weather. In addition, the tops of infested seedlings in nurseries should be clipped and burnt along with the insects.

6. THE PADDY GALL FLY

The Paddy Gall Fly *Pachydiplosis oryzae* Wood-Mason (Diptera : Cecidomyidae), is occasionally serious in Mysore, Shimoga, Kolar and Hassan ; it is a highly localised pest.

Nature of Damage and Life-History.—The larva feeds inside young rice plant and causes the growth of a long tube-like white gall in place of the stem. This is popularly known as "Silver shoots" or "*Anne kombu.*"

Eggs are reddish, elongate and tubular with rounded ends ; laid on the hairs of the ligules or on the lower surface of basal parts of leaves. The young larva creeps down between leaf-sheaths and reaches the growing point of the apical shoot or the side buds. On entering the interior of the bud, it seems to lacerate the tender tissues and feed on their nutritive juices. An oval chamber is formed round the maggot in the tissues of the growing point. Further normal apical growth being stopped, all the nutrition is directed to the walls of this chamber, which elongates like an internode. Pupation takes place inside the gall. When about to transform into the adult, the pupa with the help of the dorsal spines wriggles up the hollow tube and boring a hole at the tip with its front spines, partially projects out. The adult now emerges and flies away leaving the pupal skin. It is a small mosquito-like fly, reddish in colour and with long legs.

Control measures.—(1) Set up light-traps in the nursery and in fields soon after transplanting.

(2) Root out all seedlings showing white tubular galls and burn them.

Parasites : *Platygaster oryzae* Cameron—a larval parasite, is sometimes abundant, but is not an effective check.

7. THE RICE THRIPS

The Rice Thrips, *Thrips oryzae* William (Thysanoptera : Thripidae) is a minor pest of young paddy crop. It occurs in Bangalore, Chikmagalur, Chitaldrug and Hassan Districts.

Thrips—adults and nymphs—are found in large numbers inside the rolled up tips of tender leaves ; they lacerate the tender parts and suck up the plant sap, which causes rolling up and fading away of the leaf tips, and in very young seedlings the leaves wither and the young plants suffer. The adult insects are small and have fringed wings. Young nymphs resemble adults, but are wingless ; they feed like the parent. All the stages—eggs, nymphs and adults—are found on the leaves. When the expected rains are not received, thrips cause appreciable damage to nurseries and transplanted seedlings.

Control measures :—(1) Dust the plots thoroughly with Gammexane (5%) or fine tobacco powder.

(2) Spray with tobacco decoction.

(3) Prune the tops of infested seedlings and burn them.

The following are the other minor pests which occur occasionally in a sporadic form :—

(i) The Rice Bug, *Leptocorisa acuta* Thunberg (Hemiptera : Coreidae) : Generally not a serious pest in Mysore. Both the young and adult bugs suck

the milky juice when the grains are just forming, resulting in empty earhead The adult is an elongated and narrow greenish-yellow bug with characteris buggy smell and long legs. Hand collection of bugs or dusting with Ga mexane (5%) is advised as control measures.

(ii) The Paddy mealy bug, *Ripersia oryzae* Green (Hemipter Coccidae). An occasional pest. This is a reddish white, soft, mealy b found in colonies attached to the base of the paddy shoots covered over by t outer sheathing leaves. The damage is caused by hundreds of these bu attaching themselves to the succulent stems and sucking up the plant sap.

(iii) The Paddy Skipper, *Parnara mathias* Fabricius (Lepidopter Hesperidae): This is a dark brown butterfly: the caterpillar is smooth, gree with a distinct head, it cuts the leaves; pupation in folded leaves.

(iv) The horned caterpillar, *Melanitis ismene* Cramer (Lepidopter Nymphalidae). An elongated green caterpillar with a rough body surface a with two red horn-like processes on the head; pupation in the leaf. T adult is a dark brown butterfly with large wings.

(v) The Paddy Leaf Roller, *Cnaphalocrocis medinalas* L (Lepidopter Pyralidae). The green caterpillar rolls up the leaf tips and feeds from insi the roll; pupates inside the leaf fold. The adult is a small moth with yellowi brown wings.

(vi) The Rice Hispa, *Hispa Armigera* Oliver (Coleoptera: Chrys melidae), is a rare pest. A small bluish black beetle fringed with numero short spines on the body. The bettles eat up the green matter of leaves young plants, which causes them to fade and wither.

The Rice cockchafer (*Phyllagnathus sp.*), the climbing cut worm *Cirphis sp.*), the flower feeding blister beetles (*Epicanta*, *Lytta*, etc.) min grasshoppers (*Oxya*, etc.) and some Jassids, occasionally occur on padd Mechanical methods are employed to control these pests, wherever possibl Contact poisons can also be sprayed or dusted.

PESTS OF RAGI

1. THE RAGI STEM BORER

The Ragi Stem Borer, *Sesamia inferens* Walker (Lepidoptera Noctuidae) is a major pest of ragi, particularly irrigated (*Kar*) ragi, sometime causing substantial damage. It occurs in Bangalore, Mandya, Chitaldrug Chikmagalur and Kolar. In addition to ragi it attacks sugarcane, jola wheat, maize, and during winter, paddy.

Nature of Damage and Life-History.—The caterpillar burrows into th stem and kills the central shoot causing "*dead-hearts*"; it migrates fro plant to plant injuring many plants.

Eggs are cream white, hemispherical with ridges on the surface. The are thrust between leaf-sheaths and the stem and laid in large numbers (100-400 in rows 2-3 inches deep. The larva is long, pinkish brown with a smoot cylindrical body and red-brown head; found inside the stem. Pupation take place inside the stem or under a leaf sheath. Pupa is stout, yellowish brow in colour. The adult is a straw-coloured stout moth.

Control measures.—(1) Steep seedlings at the time of transplanting or spray the crop after transplanting with a solution of DDT; Guesoral (550)—1 lb. in 16 gallons of water.

(2) Earth up the young crop when 20 days to one month old; repeat after 15-20 days. It is necessary to sow at least 1 foot apart so as to have sufficient space for earthing up.

(3) Root out all *dead-hearts*—bearing seedlings, whenever noticed, and burn them.

Parasites: *Sturmiopsis semiberbis* (Bezzi) (Diptera: Tachinidae) *Microbracon chinensis* (Szepligeti) (Hymenoptera: Braconidae) and *Apanteles flavipes* Cameron (Hymenoptera: Braconidae) are three important larval parasites, which are however, not an effective check.

2. THE RED-HEADED HAIRY CATERPILLAR

The Red-headed Hairy caterpillar, *Amsacta albistriga* Walker (Lepidoptera: Arctiidae) is a serious pest in certain years. It occurs in Bangalore, Hassan Kolar, Tumkur, Shimoga and Chitaldrug Districts. It attacks ragi, jola, groundnut, redgram, castor, calotropis and many other dry and garden crops.

Nature of Damage and Life-history.—Hairy caterpillars are found attacking plants in great numbers and feeding voraciously on leaves during May-September. Greyish yellow, spherical, eggs are laid in batches (100 or more) on leaves or dry twigs and stubble. The caterpillars are brown, with distinct orange-red head and thick hairs on the body. They are therefore commonly known as "*Kori hula*" or "*Kambli hula.*" Pupation occurs in the soil in an oval, slightly cylindrical, reddish brown pupal case the pupal period extends to 9—10 months till early spring rains in May. The adult moth has whitish wings with black dots; a narrow yellow streak along anterior borders of forewings; abdomen yellow with black bands; there is a yellow collar and a pair of black spots on the shoulder. Female stouter than male.

Control measures.—(i) Set up light-traps soon after first showers, and repeat at intervals, to trap adult moths. (2) Hand collection of moths and their destruction. (3) Dusting the crop with a contact insecticide like BHC.

3. THE BLACK HEADED HAIRY CATERPILLAR

The Black-headed Hairy Caterpillar, *Diacrisia obliqua* Walker (Lepidoptera: Arctiidae) is sometimes very serious and often occurs in cycles, once in 4 or 6 years.

Nature of Damage and Life-history.—Caterpillars damage leaves by feeding on them. Greyish yellow eggs are laid in batches on leaves. The caterpillars are yellow, with the two ends being black and with a distinct black head; in early stage the caterpillars are gregarious and later on spread in search of food. They attack almost all garden and dry crops; pupation takes place on leaves in loosely woven cocoons of hairs. The adult moth is of brick red colour with white wings having black spots. Female stouter than male.

Control measures.—(1) Leaves of infested plants with young dark and hairy caterpillars congregating in groups, should be collected and burnt.

(2) Plots of *Kar* ragi, potato, etc., may be trenched all round to prevent caterpillars migrating thereto from surroundings.

(3) Infested plots may be dusted with Gammexane (5%).

(4) Fungus infested caterpillars should be collected and distributed over the plots and surroundings to spread the fungus.

4. THE RAGI CUTWORMS

The Ragi cutworms, *Exuoa segetum* Schiffer-Muller, and *Laphygma exigua* Hubner (Lepidoptera: Noctiudae) are two insects of considerable economic importance, and are widely distributed in Europe, Asia and North Africa, *Laphygma exigua* is a minor pest occasionally doing serious damage in the ragi nurseries. *E. segetum* was first recorded as damaging coffee seedlings in the coffee districts. More recently in July-August 1950 it wrought severe damage, when it nearly ruined, the young *hain* ragi crop over extensive areas in Gundlupet Taluk, Mysore District. Besides ragi it infested young cotton, castor, tobacco and chillies.

Nature of Damage and Life-History: As the name indicates, the caterpillars cut the young plants at the surface of the ground or a little below frequently severing small stems completely, so that the young plant is seen lying on the surface of the soil or it will be found to have been drawn partly into the ground where it withers and dies.

Eggs are pearly-white small and spherical with radiating ribs; they may be deposited singly or in clusters on the lower leaves of plants or on the soil. The newly hatched larvae are very active; they are yellow and as development proceeds, change to lead-grey with dark brown dorsal bands and black hairy tubercles and black spots on the sides (1 to 1½ inches). Pupation takes place under the ground. Pupae are dark brown conical and stout (about ⅝ inch). The adult *E. segetum* moth measures 1—1½ inches across the expanded wings, and is usually dull dusky colored, with dark brown forewings having small kidney-shaped spots, and transverse lines; hind-wings pearly white. *L. exigua* moth is also medium to large sized, dull yellowish grey with complicated patterns on the forewings. The life-history occupies 2 to 3 months—Egg: 5 to 12 days, Larva: 35 to 50 days; Pupa: 15 to 20 days.

Control Measures.—The pest is effectively controlled by distributing bran-bait in the evenings in the affected fields. The bait consists of sodium silicofluoride (1 lb.) rice or wheat bran (8 measuring *seers*), jaggery (2 lb.) and water to moisten.

Hand picking of caterpillars, spraying or dusting with Arsenate, DDT, Gammexane or Hexyclan are also sometimes employed.

5. THE EARHEAD WEBBING CATARPILLAR

The Earhead webbing caterpillar *Stenachroia elongella* Hampson (Lepidoptera: Pyralidae) is a common pest of stacked jola earheads in the Mysore District. In 1949 it was noted in harvested ragi stacks in Mandya and in the following years it appeared in a pest form in Mysore, Hassan and Mandya Districts; both *Kar* and *Hain* ragi are attacked.

Nature of Damage and Life History.—The actual damage is done by the caterpillars, which cut the hardened grains and construct webbings with frass and powdered grains; infestation starts in the field, but the damage is done in the stacks. The catterpillars are dark brown, with whitish stripes on the body. They pupate within the webbings. The moth is medium sized, dry, straw coloured with long narrow wings and is remarkable for its death feigning habit.

Control measures.—(1) Dust Gammexane or Hexyclan (2% to 5%) on the earheads of standing crop, or immediately after harvest before stacking.

(2) Thrash the stacks as early as possible to prevent great multiplication of the pest. Thorough sun-drying is very useful.

(3) Fumigation with "Killoptera" a mixture of Ethylene dichloride and carbon tetrachloride 3 : 1 is effective, but difficult to practice.

6. THE RAGI WHITE BORER

The Ragi white Borer, *Saluria inficita* Walker (Lepidoptera; Pyralidae) is a minor pest, which became rather serious last year in *hain* ragi in Kolar District. Also found on Tenai[1] and very rarely on paddy.

Nature of Damage and Life-History.—The caterpillar is a stem-borer; has a cream white colour, and is found at the lower portion of the plant close to the soil surface. Pupation inside the stem. The moth is medium-sized, greyish with a pale white band along the margin of the forewing. Moths are attacked to light traps.

Control measures.—(1) Uproot all infested seedlings (2) set up light traps in nursery, where the infestation starts, to trap moths and prevent egg laying.

Minor Pests

The following are the minor pests, which are found occasionally in a sporadic form :—

(i) The Armyworm; *Cirphis unipuncta* Haworth (Lepidoptera: Noctuidae) was noticed in a pest form in 1928, and since then it appears in a sporadic form at irregular intervals. The caterpillars are smooth, cylindrical and possess distinct brownish wavy lines on the sides; they hide among clods of earth and fallen foliage during hot parts of the day and emerge out later and climb on the plants and cause very serious damage to the crop; large numbers of this caterpillar move together from field to field. Flooding the affected nurseries wherever possible, trenching of fields and use of bran-baits are generally advised as control measures.

(ii) The looper caterpillar of Ragi-*Plusia* sp. (Lepidoptera : Noctuidae) has appeared since 1943 in a pest form in some parts of Mandya and Tumkur; it prefers *Kar* Ragi and occurs in the fields in November-December. The caterpillar is greenish grey, with warty tubercles on the body; it cuts leaf-blades under the shelter of which it lives and feeds; pupation also in the leaf folds; the moth is fairly big-sized, dirty brownish, with conspicuous patterns of white and brown makings on the forewings.

(iii) The jola grasshopper *Colemania sphenarioides* Bolivar (Orthoptera: Acrididae) attacks ragi grown amidst jola in some parts of Chitaldrug and Shimoga Districts.

The Ragi leaf-roller (*Marasmia trapelalis* Guenee), the black hairy caterpillar (*Estigmene lactinea* Cram); the jola stem borer (*Chilo*), the Ragi root aphid (*Tetraneura hirutsa* Baker) the surface grasshoppers (*Chrotogonus* spp.), the flee beetle (*Chaetocnema* sp.), and the leaf weevils (*Myllocerus* Sp.) are occasionally obtained on Ragi.

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1. *Navane. Setaria italiea*—Ed.

PESTS OF JOLA

1. THE DECCAN JOLA GRASSHOPPER

The Deccan Jola Grasshopper, *Colemania sphenarioides* Bolivar (Orthoptera: Acrididae) is a major pest of jola, but confined to South India. It was first noticed in 1909 in Mysore State. It assumed appreciable proportions between 1925-29, and became serious and extended to new areas in Chitaldrug and Shimoga districts during 1939-1945. Since then it has declined.

Nature of Damage and Life History.—The nymphs feed on growing crop and adults feed on crop flowers and ripening ears, which suffer badly. jola, ragi, tenai, pulses and grasses are attacked.

Oval, brownish eggs are laid in batches of 20 to 30 in cylindrical holes in the soil on bunds and in fields. The eggs are laid in November and December and remain underground till the monsoon of next year, *i.e.*, June-July. Young nymphs are pale and become dark as development proceeds; they are gregarious and very active and damage seedlings during August-September. The adult hoppers are also wingless with a yellowish green body with distinct green and red lines on the sides; the flowers and ripening ears are devoured wholesale by them.

Control measures:—Soon after first S. W. Monsoon showers (June) the field bunds should be dusted with Gammexane or Hexyclan in wood-ash or chalk powder (8—10 parts). This may be repeated 2 weeks later.

Use of poison-baits and hopper dosers has now fallen into disuse.

A bacterial disease sometimes kills the hoppers.

2. THE JOLA EARHEAD PESTS

Three important pests occur on jola earheads.

(i) The Jola earhead bug, *Calocoris angustatus* Lethierry (Hemiptera: Capsidae).

(ii) The Jola earhead fly, *Contarinia andropogonis* Felt (Diptera: Cecidomyidae).

(iii) The Jola webbing caterpillar, *Stenachroia elongella* Hampson (Lepidoptera: Pyralidae).

The Jola Earhead Bug.—Both the nymphs and adult bugs appear in thousands and suck up the sap from tender portions of the plant, especially from the milky earheads, making them chaffy. Shining, pale whitish cigar-shaped eggs are thrust in tender shoots and spikelets of earheads. Nymphs resemble adults but are wingless and pale green in colour; they are active and feed on tender shoots. The adults are active, yellowish green bugs with long limbs; they fly about when disturbed.

The Jola Earhead fly.—This is a small red fly, with long legs and antennae, often seen along with the earhead bug. The maggots, which breed inside tender ears, grow at the expense of the ovary and make the seeds empty. Small, transparent and narrowly oblong eggs are laid singly or in batches in the flower spikes.

The Jola Earhead caterpillar.—The caterpillar, which is brownish dark, ts the grains and constructs webbings. Eggs laid on earheads. Details are ted under Ragi. In addition to *Stenochroia elongella*, the castor pod poor, *chocrocis punctiferalis* Guenee, (Lepidoptera: Pyralidae) has recently been und to infest jola earheads and damage the grains in the same way.

The first two are, specific to jola and confined to Mysore District.

Control measures.—For the jola earhead bug and fly, as soon as earheads pear they should be dusted with a mixture of equal parts of finely powdered bacco and soap or Gammexane in 8—10 parts of ash or chalk. To be peated after 2 weeks.

For the jola earhead caterpillar, dusting with Gammexane is advised; in dition, as the caterpillars persist even after harvest, the earheads should be posed to strong sun and threshed as early as possible.

The Jola Stem Borer.—The Jola Stem borer, *Chilo zonlleus* Swinhoe epidoptera: Pyralidae) is an occasional pest occurring almost all over Mysore ate. It attacks jola, ragi, maize, sugarcane, etc.

Nature of Damage and life-history.—The caterpillar burrows through e stem and kills the central shoot causing "*dead-hearts.*" Such damage to ung plants results in serious loss. Grown up jola is also infested and in ny cases the stalks of earheads are attacked. A red fungus often follows the wake of the borer attack, and imparts to the plant a very unhealthy pearance.

Scale-like, flattish, oval eggs are laid in an over-lapping manner on the der surface of leaves. The larva is dirty white or pinkish grey with small rk warts bearing short bristly hairs; it has a brownish head. It bites its y inside the stem and burrows into it feeding on the internal tissue often ling it. Pupation takes place inside the stem. The pupa is slender and low brown. The adult is a medium sized, straw coloured moth with ominent palpi projecting from under the head.

Control measures.—(1) Early earthing up when crop is 2—4 weeks old.

(2) Root out and burn all deadheart-bearing seedlings.

(3) Dust young crop with Gammexane (5%).

The Jola Mite.—The Jola Mite, *Paratetranychus indicus* (Arachinidae) a mite pest, which breeds in jola leaves and causes unhealthy reddish tches on them; hence known as *Kumkum Roga.* The mite is small, yish green or amber coloured. Colonies of mites are found on the lower face of the infested leaves under a protective web.

Control measures.—(1) The young crop should be thoroughly dusted th sulphur mixed with ash (1:6) as soon as red blotches appear. Old, heavily infested leaves should be removed and burnt.

Other insect pests of minor importance are:—

(1) *Aphis maidis* Fitch (Hemiptera—Aphididae) Plant lice infesting der shoots—no serious damage;

(2) *Marasmia trapezalis* Guenee, the caterpillar is a leaf-roller; not important pest;

(3) The stem borer fly, *Atherigona indica* Mall (Diptera: Cecidomae)[1] the maggots feed within the tender stem at the ground level in young dlings—somstimes cause serious damage, and

(4) Other minor sucking insects, earhead caterpillars and weevils.

1. Of considerable importance in Jola areas of Bellary—Ed.

INSECT PESTS ON PULSES; THEIR IDENTIFICATION, PREVENTION AND CONTROL

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1. Dolichos lablab (Avare)

1. *The Pod Borer—Adisura atkinsoni, M.* Lepidoptera, Noctuidae).—A serious pest of lablab, this insect in its larval stages causes damage t set blossoms, developing and ripening pods by boring into and feeding o them. The eggs are spherical and are laid single in large numbers on th tender leaves, flower buds and pods. The caterpillar is cylindrical in sha and brownish green in colour. The adult moth is a pale yellowish brown straw coloured moth of moderate size. The insect pupates in the soil an remains as such till the following season of the crop.

Control.—Destroy the white round eggs by rubbing in the hand; du very young pods and flower spikes with 5% DDT. or Gammexane D.02 diluted with wood ash (1 : 6) once a fortnight, if necessary. (Prior to dustin developed pods should be picked). Release *Microbracon hebetor* Say, an *Microbracon brevicorius* Wiesm in the field.

2. *The Minor Pod Borer—Plume Moth—Sphenarches caffer,* Z (Lepidoptera—Pterophoridae).—A common pest, though not serious, of la lab, the caterpillar bores mostly into flower buds and rarely into the pod Pale yellow green minute eggs are laid on the tender shoots; and the gre caterpillar, with brown strips on the back is densely clothed with short ha and long spines. It causes damage to the developing seed and pupates on th pod or rarely in the burrow of the pod.

Control.—Dust blossoming flower buds with DDT. 5% or Gammexan D.025 diluted with wood ash (1 : 6). The dusting operation should be r peated once a fortnight if necessary.

3. *The Red-Headed Hairy Caterpillar.—Amsacta albistriga W* (Lepidoptera—Arctiidae).—A common pest of low lying crops, the caterpill of this insect feeds enormously on the foliage and causes wilting. This inse appears in large numbers and the cumulative damage is thus rather seriou The caterpillar is reddish brown in colour and possesses long hairs thickly s on its body; it feeds voraciously on the leaves and moves from field to fiel The moth is whitish with black dots on the wings having a reddish brow abdomen with black cross bands.

Control.—Hand pick and destroy eggmasses, young caterpillars on leav etc., trench around the infested field and trap the migrating caterpillars green leaves put into the trench; collect fungus infested caterpillars and dist bute in infested fields.

4. *The stink bug—Coptosoma cribraria, F.* (Rhynehota Hemipte Pentatomidae).—A small yellowish green insect it is found in large numbe clustering round flower spikes and tender shoots. The young ones and t adults suck the sap of the plant. There seems to be no perceptable dama due to the attack by this insect.

Control.—Collect adults by hand net; DDT. 5% dust has been found to effective against this insect.

IF MRIGASIRA (JUNE 8—21) RAINS, EVEN THE AGED BULLOCKS ROAR WITH DELIGHT.

5. *The Lablab Aphis—Aphis medicaginis, Koch*—(Rhynchota, Hemiptera-Aphididae).—This insect is found on lab-lab and more so on the timber variety, where it occurs in dense colonies doing serious damage.

Control.—Spray hongey oil soap or tobacco decoction in the case of climbing lablab. In the case of field lablab, spikes infested heavily with this insect may be cut and destroyed.

II. Cajanus cajan (Red gram).

1. *The Gram Caterpillar.—Heliothes obsoleta F.* (Lepidoptera, Noctuidae) A serious pest of bengal gram, this insect assumes the form of a pest on red gram lablab, tobacco, groundnut, *ganja*,[1] linseed, etc. Eggs are laid singly in tender parts of the plant. The stout, cylindrical greenish yellow to yellowish brown coloured caterpillar bores into the pods and damages the seeds within. (The caterpillar eats the leaves, bores into the pods and feeds on the seeds within). The pupa is formed in an earthen cocoon. The adult is a medium sized straw coloured moth with brownish markings on the wings.

Control.—Spray young crop with calcium arsenate. Dust infested crop with 5% DDT. or Gammexane D.025.

2. *The Plume Moth—Exelastes atomosa, W.*—(Lepidoptera, Pterophoridae).—A serious pest on red gram, the caterpiller of this insect bores into flower buds and tender pods and causes damage to the crop. The nature of damage and the control measures are the same as for the plume moth on *Dolichos lablab.*

3. *The Tussock caterpillar—Euproctis fraterna M.* (Lepidoptera, Lymantridae).—A common insect on red gram, occasionally causing appreciable injury to the crop, the caterpillar of this insect feeds gregariously on the tender leaves and flower spikes. The caterpillar is easily recognisable by its dark brown colour and a covering of hairy tufts all over the body with two elongated tufts at the anterior end and a single elongated tuft at the anal end.

Control.—Mechanical method of control should be adopted. Wherever possible DDT. 10% or Gammexane 10% may be dusted to check the insect.

4. *The red headed Hairy Caterpillar—Amsacta albistriga, W.* (Lepidoptera. Arctiidae).—Please refer under *Dolichos lablab.*

5. *The orange banded blister beetle—Zonabris (Mylabris) pustulata,* F.—(Coleoptera, cantharidae) (Meloidae).—Though commonly found on cajanus, this insect is a minor pest but occasionally, appears in large numbers and causes substantial damage to the crop by feeding on flowers and tender parts. The adult beetle is easily recognised by the characteristic orange brown coloured wavy bands.

Control.—Collect beetles with hand-net and destroy ; Dust DDT. 10% or Gammexane D.025 in patches where the pest is very severe.

6. *The Pulse Beetle—Bruchus chinensis, L.*—(Coleoptera—Bruchidae) The brownish to dark brown coloured beetle is more a serious pest of stored pulses than in the field crop. This insect is observed in the field to breed in very small numbers and perhaps serves as the source or origin of infestation to pulses in store. The very small number present in the field does not necessitate to adopt any control measure.

7. *The Gram Pod Fly.—Agromyza obtusa,* M.—(Diptera—Agromyzidae). This insect, though met with in the cajanus fields damaging the seeds in the pods, thus subjecting them to bacterial and fungoid diseases, has not so far assumed the form of a serious pest.

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1. *Cannabis sativa*—Ed.

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8. *The Togari Aphis.—Cervaphis schoutedeniae,* van der Goot.—(Hemiptera, Aphididae).—The insect, on account of the presence of meal, on its body, is rather deceptive in appearance. Whenever found, this aphid causes considerable damage—the leaves and twigs of the plant being heavily infested which very soon wither, turn yellow and die away.

Control.—Spray Hongey oil resin soap one lb. in five gallons of water.

9. *The Lablab stink bug—Coptosoma vibraria, F,* (Hemiptera Pentatomidae). This is not a serious pest on cajanus. Please refer under Lablab.

III. Green gram and black gram.—Phaseolus Spp.

1. *Aphis.*—(Aphis sp). (Hemiptera, Aphididae) This insect is rather serious pest of both Green and Black grams and causes wilting of young plants. The insects infest tender shoots and even developing pods.

Control.—Spraying hongey oil soap 1 lb. in 8 gallons of water or dusting Gammexane D.025 may be adopted in experimental plots.

2. *The Leaf-eating weevil—Alcides collaris. P.*—(Coleoptera, Curculionidae). This is not a serious pest though damage due to its feeding is noticed in fields where the crops are grown.

IV. Bengal Gram—Cicer arietinum

1. *The Gram caterpillar.*—Heliothes obsoleta, F.—(Lepidoptera noctuidae) A serious pest, this insect causes considerable damage to the maturing seeds by boring into the pods and feeding on the seeds within. For further details please refer to this insect under cajanus.

V. Horse Gram—Dolichos biflorus

1. *The Red-headed hairy caterpillar—Amsacta albistriga, W.* (Lepidoptera; Aretiidae).—Please refer to this insect under *Dolichos lablab.*

2. *The gram leaf caterpillar—Azazia rubricans, B.* (Lepidoptera Noctuidae).—This insect attacks horsegram and also the green and black grams; but it has never assumed the nature of a serious pest. The caterpillar feeds on the leaves and causes wilting of the plant.

VI. Cowpea—Vigna sinensis

1. *The Cowpea aphis—Aphis rumicis, Linn* (Hemiptera, Aphididae).—A serious pest of cowpea, the insect appears in very large numbers and suck the sap from the tender shoots and buds.

Control.—Spray Hongey oil resin soap (1 lb. in 8 gallons of water or Tobacco decoction (1 lb. in 3 gallons of water + ¼ lb. soap) when the insect makes its appearance.

VII. Green Pea—Pisum Sativum

1. *The Pea Aphis—Macrosiphum pisi,* Kalt—(Hemiptera—Aphididae).—This species always appears in a serious pest form on pea and caused considerable damage. It has been found difficult to control the insect by the use of the ordinary resin soap sprays administered against the same type of insects in general. Experimental trials have shown that Rhothane emulsion (1 in 25 of water) by volume and Folidol. 605 (6 c.c. in 2¼ gallons of water) have given satisfactory results.

VIII. Soya Bean

1. *The Leaf-miner—Stomopteryx nerteria, M.* (Lepidoptera; Gelechiiae).—The caterpillar mines into the leaves and webs them together. It is a small dark-headed, greenish caterpillar. Though a common and serious pest of groundnut, this insect is also observed frequently damaging soyabean crop.

Control.—Dust 5% B.H.C. product when the pest is observed on the crop.

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INSECT-PESTS OF SOME CASH-CROPS—NATURE OF DAMAGE AND CONTROL

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Under the group " Cash-crops ", a large number of cultivated crops may be included. Some of the important cash-crops of the State are sugarcane, cotton, groundnut, castor, potato, coffee, cardamom, tea, tobacco, areca, pepper and coconut. In the following pages some insect pests of only a few of the above crops are dealt with in brief, with control measures in each case.

Cotton

A large number insects are known to infest the cotton plant, some of them often serious pests, but a majority of them are more occasional, minor insects or casual feeders on cotton in the field: The most common insects and somtimes assuming a serious status are the bollworms—the spotted bollworms (*Earias insulana* Boisd. and *E fabia* Stoll.) and the pink bollworm *Platyedra gossypiella* Saund). The red cotton bug (*Dysdercus cingulatus* Fabr.) and the dusky cotton bug (*Oxycaraenus laetus* kby.), though often seen on cotton and other allied crops, rarely become serious pests on cotton. The insects attacking the stem—the Jewel beetle (*Sphenoptera gossypii* Kerr.) and the stem-weevil (*Pempherulus affinis* Fst.)—are of minor importance and mostly localised pests. The other insects, like the leaf *roller* (*Sylepta derogata* Fabr.), the aphid, the jassid and the mealy bugs, may be seen feeding on cotton-plant, but never have been noticed to assume a pest form.

Flower Buds, Bolls and Twigs

1. The spotted bollworm (*Earias insulana* Boisd. and *E. fabia* Stoll.) Two species are involved, and usually *Earias fabia* preponderates over the other species. The adult of *E insuala* is a medium sized, grass-green moth having white hind-wings. The moths of *fabia* differ from those of *insulana* in having yellowish head, thorax and forewings ; but the forewing is marked with a median, wedge-shaped, green band running from base of the wing to its apex. Besides cotton, the bollworm infests other allied crops, like '*Bende*" (*Hibiscus escutentus*).

Bluish-green, spherical and sculptured eggs are laid singly on tender parts of the plant. The site of feeding by the emerging caterpillar depends on the age of the plant and location of the egg. If the egg is laid on an young plant without flower buds or bolls, the larva bores down the top-shoot, as eggs in such cases are laid on tender shoots only. If the plant is with flowers and bolls, the larvae hatching from eggs located on flower-buds usually bore into buds and those on flowers and tender bolls bore into the respective plant-parts. If top-shoots are attacked, they droop, fade and finally may dry up. If flower buds, flowers and very tender bolls are infested by the caterpillars, they show holes through which excreta of the caterpillars is being thrown out and the affected parts drop off to the ground at the slightest disturbance or breeze. In the case of an older boll too, it shows a circular hole through which excreta is being thrown out, but does not drop down even after a strong breeze. Quite a serious loss of crop results from the attack of the bolloworm, as it destroys the growing top shoots, buds, flowers and eats away developing lint in the bolls leading to premature opening of infested bolls and to the invasion of other insect-pests, like the bugs. The full grown caterpillar measures about 2/3 inch long, pale green in colour dotted with black, and bearing short yellowish spines and hairs on the body. The caterpillar emerges out of the boll prior to pupation, and pupates in a boat-shaped cocoon of dirty-brown silk on the surface of bolls, bracts, or occasionally on the soil beneath the plant. The entire life cycle takes about 20-25 days, and the insect breeds throughout the year depending upon the availability of the food-plants.

Withering and drooping twigs may be collected regularly and destroyed. The caterpillars found in the buds, flowers and tender bolls may be killed easily by taking advantage of the fact that the affected parts drop off at the slightest disturbance of plants, and this method works only where there are facilities for irrigation. The plot is first irrigated so that there is standing water in the entire plot. A long rope held by two persons standing apart is passed through the affected plot, so as to dislodge all the infested buds, flowers and tender bolls on to standing water. The standing water prevents the caterpillars in the fallen bolls, etc., from crawling up again on to the plant, and the caterpillars are thus killed. If there are no facilities for irrigation, the affected flowers buds, etc., have to be picked up after dislodging them. Systematic removal and destruction of infested parts containing caterpillars early in the season, helps to check further multiplication of and damage by the pest. Dusting BHC. 5% on tender twigs and bolls periodically will also help to keep the pest in check.

2. The pink of boll worm (*Platyedra gossypiella* **Sound**.)

Like the spotted boll-worm, the pink bollworm is also fairly common, and usually occurs along with it, and at times these two bollworms together cause a substantial damage to the cotton crop Exotic varieties of cotton are known to be more susceptible to the attack of the pink bollworm. The adult is a

mall-sized, dark-brown moth with numerous blackish spots. The palpi are ong and up-curved.

Flattened, elongate, pearly-white eggs are laid singly or in small groups pon buds, flowers and bolls. The emerging caterpillars bore into bolls and eed on the lint and seeds. Occasionally the caterpillars may bore into buds lowers especially when bolls are not present, but when the latter are present ney are preferred. The external symptoms of attack on the bolls by this pecies is almost the same as in the case of the spotted boll-worm. The aterpillar, in addition to destroying lint, feeds even upon mature seeds, and nay under certain circumstances, remain over in the seeds even after harvest. The full-grown caterpillar is uniformly pinkish in colour and measures about -$\frac{3}{4}$ inch in length ; pupation takes place either in side an excavated seed, or on he surface of the stem, and more frequently in or on the soil. One generation f the insect may take from 5 to 6 weeks.

Collection and destruction of infested bolls from the commencement of he season, and periodical dusting of BHC. 5% on developing bolls, as for the potted boll-worm, will greatly help in checking the pest from undue nultiplication and consequent heavy damage in the stage of the crop. Old, broken worthless bolls have to be removed and destroyed both before and during harvest. No old plants with bolls, or other worthless bolls should be left on he field after harvest, as they provide suitable breeding place for the pink oll-worm. Only healthy seeds free from the attack by the pink boll-worm hould be selected for sowing. If small quantities are involved, immersion or 5-10 minutes in hot water (130°F) is sufficient to kill larvae, if any. Even exposing the seeds in very thin layers to strong sun may help in illing a major percentage of larvae that may be lurking in the seeds.

. **The Red Cotton Bug** (*Dysdercus cingalatus* **Fabr.**)

This bug is sometimes seen in large numbers, clustering on the bolls. ender twigs, etc. Besides cotton, the bug is found on other allied plants, like *Hibiscus*, *Bombax* and *Thespesia*. The adult is an elongate, red bug about inch long with long legs and antennae ; the forewings each with a black spot, nd the lower surface of the bug marked with transverse, white bands.

Whitish-yellow, oval eggs are laid in loose masses in cracks in the soil, nder dry leaves on the soil or at roots of plants. The young bugs emerging rom the eggs are bright-red in colour and continue to be bright-red in all the arval instars. One generation takes about 6-8 weeks. The young ones and dults cluster on bolls and tender parts and suck sap, and also suck from eeds. As a result of the sucking activity of the bugs, the lint often gets tained.

The bugs found in clusters on the cotton plants may be easily dislodged nto pans or bags and then destroyed. They may also be attracted to cotton eeds soaked in water for a few hours and then enclosed in small muslin bags. These bags are located in different places in the infested fields and the ttracted bugs are shaken off into a vessel containing water and kerosene oil. Dusting with BHC. 5 % gives good relief from the attack by the bug.

. **The Dusky Cotton Bug** (*Oxycaraenus lactus* **Kby**).

This is a comparatively small bug, dusky-brown in colour, with whitish vings. The bugs generally appear in prematurely opened boll-worm-damaged olls or even in normally opened bolls. Like the red cotton bug, it is not

confined to cotton only, but is found on various malvaceous plants. It is a minor pest on cotton, rarely doing any substantial damage.

Cigar-shaped, longitudinally grooved and whitish eggs are laid on the seeds inside the lint, and occasionally between the boll and the calyx. The young bugs and adults are usually found inside the lint or on dry old bolls. Sometimes during ginning of cotton, the bugs, which may be present, get crushed and stain the lint.

The bugs may be dislodged from the bolls by shaking into bags or pans containing water and kerosene, dusting with BHC. 5% will be quite effective against the bug.

Occasionally mild infestations of mealybugs (*Pseudococcus* spp.) have been seen on the tender twigs and leaves. They have not so far been observed to be of any importance on cotton.

Foliage

The leaf-roller (*Sylepta derogata* Fabr.), though sometimes seen here and there in the cotton areas of the State, has not become a serious pest, and when it appears is usually confined to certain limited localities. The adult is a yellowish moth with brown wavy markings on the wings. Exotic varieties of cotton are especially liable to attack.

The entire life-cycle is passed on the cotton plant. The catterpillar which measures about one inch in length when full-grown is green in colour with the head and prothorax dark. It rolls a leaf and lives within the leaf-roll, feeding on the leaf-tissue inside. The caterpillars can be easily dislodged from their leaf-rolls by shaking the plant.

The cotton-aphid (*Aphis gossypii* Glov.) is usually seen in numbers, especially on the lower surface of leaves and sucks plant sap. The aphids are greenish-yellow or pale green in colour, and generally, all stages of the insect are distributed on the entire lower surface of the infested leaf. The plant-lice never become a serious pest in the fields. Cambodia cotton appears to be preferred by this insect.

There is another sucking insect which may be occasionally seen on the lower surface of leaves. This is a green leaf-hopper (*Empoasca devastans*) which also passes its entire life-cycle on the leaves, and has not been noticed to assume the status of a pest.

The sucking insects infesting the foliage may be controlled by spraying hongey oil soap or fish oil soap (1 lb. in 8 gals. of water) or tobacco decoction (1 lb. in 4 gals. of water). Special attention must be paid to spraying the lower surface of leaves. All opened bolls, if any, should be removed before spraying, as otherwise the lint gets stained with the spray. Dusting with BHC. 5% gives good relief against the leaf foller and also sucking insects.

Stem

There are two important insects that infest the stem portion of the cotton plant. Both are more or less localised in regard to their occurrence in the State. The stem weevil, (*Pempherulus affinis* Fabr.), is a highly localised pest confined to T. Narasipur Cotton areas in the south, and the stem borer, jewel beetle (*Sphenoptera gossypii* Kerr.) is confined to the cotton areas in the northern part of the State.

The adult of the stem weevil is a small dirty-brown weevil, about ⅛ inch n length, and possesses a conspicuous, curved snout. It is very active. enerally, young plants are attacked in the field, though older plants are not ntirely free from the attacks by this pest.

Shining, whitish eggs are laid just under the outer surface of the stem of ne growing plant. Whitish-yellow grubs that hatch out of the eggs bore rough and get into the region between the bark and the main stem, and here ney make irregular galleries in the limited space. As a result of the grubs eeding inside, a local gall-like swelling appears on the stem. Several grubs ay be present inside a single gall. The affected plant is liable to breakage at ne point of attack in case of a strong wind. Even otherwise infested plants re sickly and may even die prematurely depending upon the age and growth f the crop.

The stem borer jewel beetle is a shining deep bronzy-black insect, easuring about ½ inch in length.

Eggs are laid on the bark, generally about midway between base nd crown of stem. The larva, on emerging from the egg, bores into ne stem, and tunnels a gallery up and down the centre. Pupation kes place in the larval gallery. The attacked plant droops, withers and nally dries up. Cambodia cotton appears to be more susceptible to attack an other varieties.

Prompt removal and destruction of affected plants is the only possible emedy that can be suggested to check the multiplication of the weevil and ne beetle pests. Plants broken off by wind, due to the attack by the weevil, hould be collected and destroyed.

GROUNDNUT

There are a number of insects which may be occasionally or rarely seen n the groundnut crop, but only two insects the leaf-miner (*Stomopteryx erteria* Meyr.) and the aphid (*Aphis laburni* Kalt.) are of importance.

1. The Leaf-Miner (*Stomopteryx Nerteria* **Meyr**) The leaf-miner is ccasionally a serious pest on groundnut crop, and the crop grown nder irrigated conditions appears to be more susceptible to attack than ne one grown under rainfed conditions. Though the insect is seen in mall numbers here and there in any groundnut area, it assumes a est form only in certain years. Besides groundnut, the leaf-miner is seen to reed in soyabean and rarely in *Cajanus*. The adult a very small dark-brown oth with a conspicuous small white dot at the front margin of each upper ing. It is very active during night and hides under clods of earth, or below aves, etc., during daytime. In a badly infested field, if the plants are sturbed, a large number of moths come out of the bush and fly aimlessly and oon hide in some place.

Minute, sculptured eggs are laid singly on the leaves, especially on the wer surface and on shoots of the groundnut plant. The caterpillar n emerging, mines into the leaf-let, the mine showing up as a yellowish-rown blotch on the surface. As the caterpillar grows, it comes out the mine, brings together two or more adjacent leaf-lets and lives ith in the fold, feeding on leaf-tissue. A full-grown caterpillar is about ne-fourth of an inch long and dark green in colour. The webbing of

the leaf-lets may be seen about one week after the emergence of the caterpillars from the eggs. A badly infested field appears as though all the plants are burnt or charred. Groundnut crop in the younger stages, if attacked by the leaf-miner, is more susceptible to the damage and the yield is very adversely affected, than in the case of the older crop. Pupation takes place among the folded leaves. One generation requires only 20-25 days for completion.

The infested crop may be dusted with BHC. 5 % as soon as yellowish-brown blotches on the leaves are seen, and again a fortnight later. Light-traps to attract the adult moths and to kill them may be set up with advantage in the infested fields.

2. **Groundnut Aphid**—*Aphis Laburni* **Kalt.** In recent years the aphid pest of groundnut has assumed a serious status especially in the northern parts of the State. The pest is seen at any stage of the crop, but particularly serious and destructive on young crop. In cases of severe infestation, the stem upto the ground level and even a little below if the soil is loose around the stem, the leaf stalk, the stalks of pods and occasionally foliage are infested by the aphid, and the infested portions are not seen unless the thick coating of aphids on them is removed. Some of the badly infested fields in the early stages of the crop have been seen to be completely destroyed and had to be re-sown.

The pest can be successfully controlled provided it is tackled in its early stages. Usually infestation starts even when the crop is a week-old (week after sprouting). Treatment should be commenced at that stage and continued for about a month or more, if necessary. The treatment consists in thorough dusting of the entire crop in an area with B. H. C. 5 % periodically at an interval of two weeks.

The blister beetles which are seen rarely feeding on flowers, the leaf eating grasshoppers and caterpillars which are also seen occasionally, are not considered as pests of any importance on groundnut crop.

CASTOR

Among the insects attacking the foliage, the most common and often serious pest is the semilooper, *Achaea janata* Linn. which is specific to castor. There are various other leaf eating insects, like the castor slug, the tussock caterpillars and the hairy caterpillar, which are sporadic pests of minor importance. The Castor pod-borer (*Dichocrocis punctiferalis* Guen. is often a serious pest upon the pods and sometimes shoots.

Foliage

The Castor semilooper (*Achaea janata* Linn). The semilooper occurs year after year on castor crop, and is often a serious pest. The adult is a stout, greyish-brown moth with black and white blotches on the hind wings.

Greenish-brown eggs are laid singly on the tender shoots and leaves. The caterpillars on emergence from eggs begin to feed on the foliage. The caterpillars are voracious-feeders and the later stages are particularly so. Severely infested fields show plants almost completely defoliated, and in certain localities vast areas of entirely defoliated castor crop is seen during October-November months, owing to the ravages of mostly the semilooper. The fullgrown caterpillar is about two and a half inches long, smooth, elongated, and dull greyish-brown in colour with whitish stripes along the body

ne caterpillar in all its instars moves about in a looping manner and hence name, semilooper. Pupation takes place generally in folds of dried leaves the soil, and occasionally in the soil. The entire life cycle from egg to ult occupies about one month.

If it is a small area, the caterpillars can be easily handpicked, as also e pupae in the dried leaves on the soil, and destroyed. Broadcasting of oked rice or other food will help in reducing the semilooper population in e infested field ; as this would attract crows and other birds which may ed upon caterpillars Application of a spray containing a mixture of lcium arsenate (1 lb.) lime (2 lbs.) and jaggery or molasses (3 lbs.) in 50 s. of water effectively controls tho semilooper as also most of the other af eating caterpillars.

The other leaf eating caterpillars which are comparatively minor and less gular are the tussock caterpillars (*Orgyia postica* Wlk. and *Euproctic* spp.), nich appear on small patches here and there in an area. Of the two or more ecies of tussocks, *Orgyia postica* is more common. In this species, the male is a wingless, sluggish moth, pale brownish in colour. The male is nged, active and attracted to light. In species of *Euproctis* both sexes are nged, and yellow coloured with a few small, dark spots on the wings.

Eggs are laid in clusters covered with fine hairs derived from the anal ft of the female. The larvae are usually yellowish with tufts of hairs on the dy, the number and location, shape and size, etc., vary a little from species species. Pupation takes place between the leaves or on the twigs in an llowish-grey cocoon of silk and hairs.

There are various other leafeating caterpillars, like the cutworm *rodemia litura*, Fabr.), the black headed hairy caterpillar (*Diacrisia liqua* Wlk.), and the castor slug (*Parasa lepida* Cram.) of which the slug terpillar is a sporadic minor pest on castor, and the cutworm is occasionally en feeding on the leaves.

By the application of a spray containing a stomach poison, like calcium senate, all these leaf eating caterpillars can be controlled. The eggs, in all ese cases are laid in clusters, and the emerging caterpillars are naturally egarious soon after hatching and usually feed gregariously in their early age for some time. Such gregarious caterpillars may be collected easily and stroyed.

ds and Shoots

The only pest that is seen to attack this portion of the plant is the borer *ichocrocis punctiferalis* Guen.). This insect has a very wide range of host ants, including guava, tamarind, jawar, turmeric, cardamom, etc., the cater- lars feeding on fruits, seeds and stem in different host plants. The pod- rer is usually seen infesting capsules and top-shoots in a mild form ; but comes a pest only occasionally, when it considerably affects the yield.

Eggs are laid on the tender parts of the plant, and the caterpillars on tching bore into shoots in younger plants, and in the case of the plants with wer spikes and pods they may bore into the stalk of the flower-spike and so feed on the developing, tender pods by webbing them together and destroy- g the entire spike or a portion of it. Their main damage consists in boring to the older capsules, feeding on the inner seeds. The external symptoms attack is the presence of webbing and excreta on a number of tender pods or

on surface of the shoots, and capsules showing holes through which excreta is being thrown out.

The full grown caterpillar is about an inch and quarter in length and reddish in colour. Pupation takes place in a silken cocoon, either inside the burrowed top-shoot, or in the capsule.

Removal and destruction of affected portions, regularly, helps in killing and reducing the borer population. Dusting with BHC. 5% on the infested spikes and the just forming spikes gives good relief from the damage done by this pest.

POTATO

The Potato-Epilachna pest (*Epilachna 28—punctata* Fabr.) is usually a serious scourge on potato-growing, especially in the extensive potato areas (Bangalore and Kolar districts) of the State. Every potato-grower in these areas knows well the amount of destruction this small beetle-pest can cause to his crop, if the pest is left to itself unchecked. The adult is a roundish, highly convex yellowish-brown beetle characterised by the presence of a number (28) of dark spots on the dorsal surface. The lower surface is flat and yellow in colour. Besides potato, it feeds on brinjal, cucumber, melon, etc. The damage to the foliage by feeding is done both in the larval and adult stages.

Yellow, elongate-oval eggs are laid in groups particularly on the lower surface of leaves, each egg standing on one end. The grubs, on emergence from the eggs, begin to feed on the foliage and grow in size. The body surface is beset with small spines on the dorsal surface. Pupation takes place on the under-surface of leaves, the pupa being attached to the substration by its posterior end. The grubs and adults feed voraciously on the foliage especially on the lower surface, causing characteristic pale-whitish, linear patches on the leaves. In cases of severe infestation, the infested leaves gradually dry up, and sometimes the entire plant dries up. One generation takes about 15-20 days.

Two applications of a spray containing calcium arsenate (1 lb.), lime (2 lbs.) and jaggery or molasses (3 lbs.) in 50 gals. of water give complete control of the Epilachna pest. The arsenate, lime and jaggery have to be made into solution separately in small quantities of water before mixing up. The first application may be made when the crop is 3-4 weeks old, and the second when it is about 8 weeks old. In small areas, handpicking of grubs, pupae and adults early in the season and even later will be helpful in keeping the pest under check.

The other serious pest, mainly on tubers in store, is the **tuber moth** (*Phthorimoea operculella* Zell.). The infestation of the tubers, sometimes starts in the field and is carried to the store where it multiplies to alarming proportions, if unchecked. The adult is a small dull-grey moth with narrow fringed wings, and is very active.

Pale-white, spherical eggs are laid in small groups or singly, usually on the eyes of the tubers. The caterpillar bores into the tuber and grows to about $\frac{1}{2}$ to $\frac{3}{4}$ inch in length, and is pale-pinkish in colour at this stage. The boring of the caterpillars is mostly in the peripheral region of the tuber, although deeper portions are attacked later when food in the peripheral portion is exhausted. The infested tubers show discoloured patches on the tunnelled portions. The discoloured and bored tubers, besides losing the food

alue coniderably, are unfit for marketing and their market value is entirely ost. The full-grown caterpillar comes out of the tuber and pupates in a oarse silken cocoon on the tubers or on the gunny-bag in which the tubers re stored.

Control measures against this serious pest become necessary mostly just efore and during storage of tuber, and they consist mainly in the proper reservation of tubers. The tubers may be preserved under a $1\frac{1}{2}$ inch ayer of sand and frequently aerated. The infested tubers may be separated, s far as possible, before preservation under sand. Tubers intended for eed-purposes, may be treated with DDT. 5% dust, or BHC. 5% dust, which eeps the infestation in check.

TOBACCO

Tobacco crop is subjected to the attack of the stemborer (*Phthorimoea*) *Gnorimoschetra heliopa* Low.), the leaf-eating caterpillar (*Prodenia litura* Fabr.), and the plant-lice (*Myzus persicae* Sulz.), and rarely certain species of rasshoppers which feed on the foliage.

tem

The Stem Borer (*Phthorimoea*) *Gnorimoschetra heliopa* **Low.**—This is sually a serious pest on tobacco, particularly the cigarette tobacco known as *larrison's Special.* The adult is a yellowish brown small moth, allied to the otato tuber moth. The moth is very active.

Small, greenish-yellow eggs are laid singly on the leaves. The caterillars emerging out of the eggs, mine into the leaf tissue, bore through the id-rib of the leaf and finally get into the stem During the process of feeding the stem, a characteristic gall-like swelling is formed on it. The fullgrown aterpillar is about 10 mm. long and pale pink in colour. Pupation takes lace in a silken cocoon inside the gall-like swelling. The entire life-cycle akes 45-50 days. Infestation usually starts in the nursery stage of the crop, nd is carried to the field along with the transplanted crop. In the nurserytage some of the plants attacked by the borer may finally die due to the illing of the growing point of the affected plant. After transplantation of the eedlings, the infested plants may show wilting of top-shoots and issuing of de branches, in addition to the presence of gall-like swelling on the stem. fter the plants are well-established in the field, no appreciable damage is one by the borers though a large number of them may be found inside a ngle stem.

Regular spraying of the nursery beds with calcium arsenate once in a eek, and covering the nursery-crop completely with a thin muslin cloth uring night times to prevent egg-laying by moths are useful in keeping the est under control to a considerable extent. Careful selection of only healthy eedlings for transplantation and destruction of all the remaining untransanted seedlings in the nursery beds will go a long way in minimising the amage done by this pest later in the field. The galls on the stem may be plit by means of a sharp knife, and the larvae inside may be crushed by a entle pressure on the split-gall.

The leaf caterpillar (*Prodenia litura* **Fabr.**)—Occurring on various dryand and garden crops, this caterpillar pest is sometimes serious on tobacco op, and particularly in the nursery stage of the crop. The adult is a darkrown moth with white line-like markings on the fore-wings.

Eggs are laid in clusters each covered over with brown hairs derived from the female moth. In the earlier stages the caterpillars are gregarious and feed voraciously on the foliage. The full grown caterpillar is about 1½ inches long cylindrical, smoth and varying in colour from greyish-green to greyish-brown. Pupation takes place within the soil in an earthen cocoon.

As it is mostly serious in the nursery stages, periodical spraying of the nursery-beds with calcium arsenate will largely control this pest. Poison bait, consisting of sodium silicofluoride (one lb.) wheat or rice bran (4 lbs.) and molasses (one lb.) with a small quantity of Amyl acetate and enough water, may be spread in the nursery and also in the field for attracting caterpillars to the poisoned bait and killing them.

The Plant Lice (*Myzus persicae* **Sulz.**) The green aphid is often found in large colonies particularly on the lower surface of leaves. As a result of the attack, a black fungus is attracted to the 'Honey dew' secreted by these insects and covers the leaf-surface, which seriousiy affects the quality of the tobacco leaves. Due to the sucking activity of these plant lice, the plant may appear sickly.

Spraying with Hongey oil soap or Fish oil soap (1 lb. in 8 gals. of water), especially on the lower surfaces of leaves, gives good relief from the damage by these plant lice.

Occasionally certain species of grasshoppers (*Atractomorpha* sp., *Chrotognus* sp. etc.) are noted to do slight damage to the foliage, and they do not normally become pests.

COFFEE

The most common and destructive insect pest of Arabica Coffee is the stem borer *Xylotrechus quadripes* Chevr., which is distributed throughout the coffee areas, excepting at very high altitudes (5,000 ft. and above) where it is known to be almost absent. It is not known to breed in Robusta and other varieties of Coffee in nature though they are grown by the side of Arabica Coffee which is highly susceptible to the attack of the stem borer. The beetle is bluish black, elongate and measures about ½ inch in length, and possesses characteristic white markings on the wing-covers.

Milky white and elongate-oval eggs are laid singly in the cracks and crevices on the scaly-bark of the stem. The whitish grub that emerges out of the egg tunnels into the stem, feeding on the wood. For the first few months the grub tunnels just below the bark round the stem and then gradually gets into deeper portions of the stem tunnelling in all directions. The galleries are tightly packed with dust. As a result of the tunnelling by the grub in the peripheral region of the stem, a few ring like ridges appear on the stem, and this is the indication that tne plant is attacked. Pupation also takes place within the stem, and the beetle emerges through a circular hole on the stem. One generation takes about one year and usually a large number of beetles emerge during October and November months (known as the major emergence). It is seen that the pest developing in young plants and cut-stem takes a lesser time of 6—8 months to complete its life-cycle, thereby giving rise to another emergence of beetle in the year, known as the minor emergence, during March—May.

Shade-regulation so as not to leave open sunny patches in the estates, scrubbing the stems of the plants, especially during November-December, at least once in two years, and up-rooting of infested bushes once before

eptember and again in February-March and destroying them by burning mmediately after removal are the preventive methods of control advised to ie planters, which, if practised systematically and promptly, go a long way in educing the damage done by this pest. Thes e control measures, particularly emoval and destruction of infested plants should be carried out on a co-perative basis over the entire area, and a Pest Act has been in force in the offee areas to see to it.

The Shot-Hole Borer (*Xyleborus Morstatti* **Hag.**) This is another ommon, but much less serious pest on particularly, Robusta coffee. Here it s only the twigs that are affected by the borer and the damage done is often egligible. The adult is a small (2.5 mm. in length), brown scolytid beetle ossessing a short and almost cylindrical body.

Minute, white eggs are laid in small clusters in a small gallery made by ie female beetle on a twig for the purpose. The larvae that emerge out of ie eggs feed mainly on a fungus (Ambrosia)) developed on the walls of the allery, and pupate inside the gallery after the larval period. As a result of he tunnelling of the gallery on the shoot by the female beetle, the portion of he twig beyond the tunnel may wilt and sometimes may dry up. There are ases in which the wilting twigs have recovered after healing of the gallery.

Infested branches and twigs showing wilting may be pruned and destroyed wice a year during summer and autumn months. Heavy shade over the lantation mao be avoided.

There are a number of insects that attack the foliage and tender twigs, of vhich may be mentioned the scale insects and the mealy bugs (*Lecanium iride* Gr. *Saissetia hemispherica* Torg. *Pulvinaria* sp. and *pseudococcus* sp.) nd the winged grasshopper (*Aularches miliaris* D.) of Coffee. These insects ave never been a problem, except localised infestations of the Coffee Green 3ug (*L. viride*) in certain years. The green-bug infestations are controlled y spraying a contact insecticide, like Hongey oil soap or fish oil soap.

Occasionally, coffee crop is subject to the severe attack and defoliation f a sporadic pest, the cardamom hairy caterpillar, which will be dealt with nder pests of cardamom.

CARDAMOM

The Cardamom Thrips (*Taeniothrips cardamomi* Ramk).—The thrips are ften found in large uumbers infesting the growing flowers, buds and fruits and uck up sap. As a result of a large number of these insects sucking sap, the etting of fruits may be affected and the affected fruits are reduced in size and nalformed. The insect is very small in size (1.5 mm.), pale-yellow in colour nd possesses narrow ribbon-shaped wings fringed with long hairs.

Application, of a spray containing tobacco decoction and hongey oil soap r washing soap (one lb. tobacco and 1/8 lb of soap in 3 gals. of water). The pplication of the spray may be commenced from the time the green pods are ormed and continued at fortnightly intervals till the pods ripen.

The Cardamom hair caterpillar (*Eupterote canaraica* **Moore**.—This is a poradic pest, believed to appear in cycles of 10-12 years. When it occurs in . pest-form, it is usually very serious defoliating entire plantations in certain ocalities. The adult is a fairly large-sized, yellowish-brown moth, with wavy narkings on the wings.

MAKHA RAINS (AUG. 17—30) EITHER COME IN DOWN POUR OR GO UP AS JUST VAPOUR.

Groups of eggs are usually laid on the leaves of shade-trees during the south-west monsoon rains. The caterpillars, in their younger stages, feed for some time upon the foliage of shade-trees, and then hang down by means of silken threads and reach at the plantation below. They are voracious feeders and often defoliate the infested area (Cardamom or Coffee). The full-grown caterpillars have the habit of congregating in large numbers in various sheltered positions in the estate. They pupate in the mixture of loose soil and their excreta on the surface of the soil or slightly below the surface of the soil. Moths emerge in large numbers just after the early showers of south-west monsoon rains next year.

Usually large numbers of caterpillars, are killed in certain localities by a white fungus. Distribution of fungus-infested caterpillars into areas where the fungus is not evident helps in spreading this natural enemy, and controlling the pest. Collection and destruction of congregating larvae, and pupae formed at the bases of trees, etc., helps in reducing the pest population.

The Castor Pod-borer, (*Dichocrocis punctiferalis* Guen.)—which has a wide range of hosts, infests cardamom, occasionally, the caterpillar boring into the stem and causing typical "dead hearts" (drying of the central shoot). It has never been a serious pest. The infested tillers have to be removed along with the borer inside and destroyed.

IMPORTANT INSECT PESTS OF FRUIT CROPS-NATURE OF DAMAGE & CONTROL

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Among the fruit crops raised extensively in the State may be mentioned the *Citrus* spp. (Oranges, Lemons, etc.), mango, plantain and guava, jak, pomegranate, papaya, grape-vine and apples are grown less extensively, and in most cases they are found as scattered stray plants or in the form of small orchards. The other fruit-crops, like peach, fig and sapota occupy a very minor place as the extent of land coming under these crops or the number of plants grown, is very low.

ORANGE, LIME AND POMELO, ETC. (*Citrus* spp.)

Among the insect pests that usually attack this group of fruit plants, the most common and often serious are the stem borer and the butterfly. Other insects that may be sometimes seen feeding upon tender twigs and foliage are the leaf-miner, the black fly (*Aleurocanthus* spp.), and some sap-sucking mealy bugs, scale insects and aphids, which rarely become pests. Though sometimes fruit flies and rarely fruit-sucking moths attack the fruits, they are not considered as pests. The various insects attacking different regions of the plant are grouped separately as insects feeding upon particular portions of the plant, for purposes of study.

Stem

The Steam borer (*Chelidonium cinctum* **Guer.**) It is the only stem-boring insect that is of importance, as it sometimes becomes a pest, the larva boring into the branches and the main stem. The adult is an elongate, bluish-green beetle about one and a quarter inch in length, with long antennae, and the wing covers possessing a yellowish cross-bar across the middle.

In makha, rain drops are as big as *Mage* (small pot).

Lemon-yellow egg is laid at the angle of a forked twig. The larva, on ierging out of the egg, bores into the twig and grows in size by feeding on e tissues. The attacked twig gradually withers as a result of the feeding tivity of the larva inside. The larva then eats its way towards the main em through the branch and during its course, it tunnels in all directions with the wood. The infested plant shows at frequent intervals, circular holes on e surface of attacked branches and stem, through which the excavated wder is thrown out. Pupation takes place inside the stem. The insect sses through only one generation in a year, the beetle usually appearing from ddle of May to middle of June.

The best time to tackle the pest is when it is still within the twig in its rly larval stage, as otherwise it is not so easy to kill the grub when it has eady entered the stem. The infested twigs may be removed by means of a g pole ending in a fork and the removal should be systematically attended at least once during the last week of June and again a month later. When e larva is found within the branches or the stem, which is indicated by the esence of a large number of holes on the surface of the attacked portion, ection of an insecticide, having a fumigant action, into the larval tunnels to l the larvae inside, has to be taken up. For this purpose such of the holes rough which fresh excavated powder is thrown out are selected and the rest sed by moist earth. A 50 per cent phenyle solution is then injected into the ected holes by means of a syringe and the holes closed up by moist earth

igs and Foliage

The Citrus Butterfly (*Papilio demoleus* L.) At times citrus plants rticulary young plants, suffer most by the destructive nature of this st, the caterpillar of which feeds on the foliage. The adult is a large ed bluish green butterfly having a characteristic ornamentation of merous yellow spots on the wings, and the hind wings are further aracterised by a brick-red oval patch at the posterior end of each.

Eggs are laid on the lower surface of tender leaves, and the caterpillars, emerging, begin to feed on the foliage and grow in size. In their early ges, they are a curious blend of black and white colour and resemble birds' ppings. However, in their later stage and before pupation they assume a en colour with characteristic stripes. Their voracious feeding and capacity damage is particularly evident in the case of young plants which may times, be completely defoliated. Pupation takes place on the leaf or twig, e pupa being suspended obliquely in the characteristic way.

If stray plants in the younger stages are attacked by the pest, the terpillars may be easily collected and destroyed. If the infestation is seen almost the entire orchard, spraying with calcium arsenate may be taken . Formulation: 1 lb. of arsenate, 2 lbs. of lime and 3 lbs. of molasses jaggery), each to be made into solution in water separately and then mixed d the mixture made up to 50 gallons for spraying.

One of the other insects that attack the foliage is the **leaf miner,** *hyllocnistis citrella* Stt.), a tiny silvery white moth, the caterpillar of which nes into the tissue of leaves of young plants or younger leaves of aged plants. e mines in the leaf tissue and occasionally in tender twigs show up as itish, linear and zigzag patches on the surface, and the feeding activity of e larva inside the leaf tissue may in some cases, lead to deformation, mpling and finally premature fall of the infested leaves. It rarely assumes est form, and if noticed as stray cases, the infested leaves, showing linear, zag patches on the surface, may be removed and burnt.

The only other group of insects that are occasionally seen upon tende twigs here and there come under the group of sucking insects. They are th mealy bugs (*Pseudococcus* spp. and *pulvinaria* sp.), a few species of har scales (Coccidae), the citrus black fly (*Aleurocanthus woglumi* Ashby an *A. spiniferus* Quaint.), and an aphid (*Aphis tavaresi* Del Guercio). Thes sap-sucking insects are usually found in a mild form here and there, and the spread may be checked by periodic pruning of affected twigs and destroyin them, or, if necessary, a contact insecticide may by applied to control thes insects. Spraying of tobacco decoction (1 lb. in 4 gals. of water) or Honge oil soap or fish oil resin soap (1 lb. in 4 gals. of water) will give good relief.

Fruit

As already pointed out, the fruits of various species of *Citrus* do no suffer to any considerable extent from infestations of insects. Occasional they are subject to the attacks of the fruit flies (*Dacus* spp.) which do no assume a serious pest-form. Though our collections of insects show son species of fruit-sucking moths (*Ophideres* spp. *Achaca janata* Linn., etc actual observations on their fruit-sucking habit are wanting.

MANGO

The most common and the most serious insect-pest is the mango hopp (*Idiocerus* spp) which is regularly destructive year after year, and to a less extent the fruit flies (*Dacus* spp.) forming a minor pest. The Castor slu caterpillar (*Parasa lepida* Cram.) is a sporadic pest on mango, sometim defoliating trees in certain localities. The other minor pests of mango a the nut-weevil (*Cryptorhynchus mangiferae* Fabr.) the stem borer (*Batoca rufomaculata* De. Geer), and various sap, sucking mealy bugs and oth coccids.

Flower Spikes and Tender Twigs

The Leaf-hopper (*Idiocerus niveasparsus* LETH, *I. atkinsoni Leth. a I. clypealis* LETH.)—The mango hopper is usually a bad pest which occu regularly in innumerable numbers on almost every tree during the blosso season. The adult is a small wedge-shaped, greenish-brown insect.

Minute eggs are laid, inserted into the tissues of the rachis of t inflorescence, or in any other tender portion. The nymphs, soon after hatc ing are quite active and move about rapidly along the flower spikes, shoo and feed on the plant-sap. The presence of these insects is indicated by t shower of 'honey-dew' (a sweet secretion from thousands of these insec one experiences while passing under a heavily infested tree during t blossom-season. The foliage and twigs of an infested tree present a bla fungus attracted to the 'honey-dew'. Both adults and nymphs suck s from tender portions, particularly flower-spikes. As a result of the hea drain of sap due to the feeding activities of a large number of these hoppe the setting of fruits is severely affected, and results in a premature dropping o large number of tender fruits, to which a fungus disease also contributes. T hopper is present during other seasons of the year also on the bark of the tre trunk in very small numbers, but during the blossom-season, it multipl enormously and assumes a pest form.

The infestations of the hopper can be successfully controlled by app cation, of a spray containing a contact insecticide like 'hongey oil' soap fish oil soap.

PUBBA (AUG. 31—SEPT. 12) EITHER ROLLS DOWN IN TORRENTS OR FALLS APART LIKE CHAFF.

Recently, applications of a spray containing a suspension of wettable DT. has been found to be satisfactory and is being widely used. One lb. a 50% DDT. is made into a thin uniform paste in water and then it is luted to 16 gallons by adding water. Two sprays so as to entirely cover e blossoms and tender twigs, once when the blossoms begin to appear and gain a month later, are necessary.

oliage

Among the insects that attack the foliage, the Castor slug caterpillar, *arasa lepida* Cram., is an important one, as it sometimes becomes a rious pest, defoliating younger plants and at times even big trees. It has irly a wide range of hosts, including castor, plantain and *Ficus* spp. The dult is a medium-sized greenish moth with characteristic green and black arkings on the fore-wings.

Batches of scale-like eggs are laid in an overlapping manner on the nder parts of plant. The caterpillars in the earlier stages are gregarious d feed voraciously on the foliage. The full grown caterpillar is flatish, short nd stout and moves like a slug. The surface of the body is covered with fts of spines and hairs, situated in rows. These spines and hairs leave a ad irritation on the skin, if touched. Pupation takes place, usually, away om the place of larval feeding, on the tree-trunk or on the walls, etc., of eighbouring buildings, within very tough, oval cocoons.

Collection of young caterpillars, while they are still in the congregating age may be taken up, if possible. Destroying of pupae on the tree-trunks and alls, etc., which is easily done, will go a long way in lessening the attack by is insect next year. Application of a spray containting calcium arsenate, me and jaggery (1 : 2 : 3) to cover entire foliage gives a successful control of e catterpillars feeding on the foliage. This chemical should not be applied hen the plant is bearing fruits.

The other insects that attack the foliage are of very minor importance. hey belong to the group of sucking insects and comprise the mealybugs *ulvinaria* spp. and *pseudococcus* spp) and some scale insects, particularly *hionaspis vitis* Green (the mango mealy scale). These insects, usually, do ot assume a pest form, though a few or more species of these sucking insects ay be present in small numbers on the foliage and shoots of mango, *ulvinaria* sp. occasionally, assumes a serious form, but it is usually controlled y its various natural enemies, before it does considerable damage to the fested plant.

tem

There are no pests of any importance affecting the stem portion of mango, ough some insects like *Batocera mofomaculata* De Geer. (the fig tree borer) nd *Arbela tetraonis* Mo., the larvae of which bore into the stem, are seen.

ruit

The fruit flies (*Dacus* spp.) are the most important of insect pests that tack the mango fruits. The adult is a small fly of the size of the common ousefly, and is yellowish brown in colour with transparent wings having int smoky patches. The abdomen is pointed at the tip.

Minute, cylindrical eggs, white in colour, are laid into the pulp beneath e outer rind. The maggots after emerging from eggs, feed on the pulp inside nd complete their growth in 4-10 days. Usually an oviposition puncture can e made out, by the presence a scar and resinous secretion near it. After the

maggots begin feeding just under the area where eggs were laid, the particular region of the fruit becomes soft to touch and slightly discoloured. If the fruit is heavily infested, the pulp inside is completely spoilt and unfit for consumption. The full-grown maggot gets out of the fruit, drops down and enters the soil underneath the infested plant for pupation. Pupation takes place 1-3 inches below the surface of the soil. One generation may take 15-20 days, and there may be as many as 3-4 generations during the mango-season.

As the egg and larval stages are passed through, concealed, within the fruit, the control measures have to be directed towards attacking the pupal (in the soil) and the adult stages. The pupae that are found in the soil may be exposed to lizards and other enemies by raking the soil underneath the trees up to a depth of 3-4 inches. Poison bait contained in tins having cotton wicks through which the liquid bait slowly trickles down, may be regularly set up in the mango gardens during the season to attract and kill the adult flies. The bait is prepared by mixing calcium arsenate in sugar solution to which a small quantity of Citronella oil is added. The bait is placed in tins having holes through which cotton wicks are protruding out. The tins are hung inverted so that the protruding wick is fully saturated with the bait, for the flies to suck up.

The other insect, which infests only certain varieties of fruits is the nut weevil (*Cryptorhynchus mangiferae* Fabr.), the grub of which feeds on the kernal within the 'stone' and does not damage the pulp. For this reason, it is not considered as a pest.

GUAVA

Among the insect pests of guava, the guava bug (*Helopeltis antonii* Sign.) is the most common and often a serious pest causing blisters on the fruits. The mealybug (*Pulvinaria psidii* Gr.) and other scales, like the coffee green bug (*Lecanium viride* Gr.) and sometimes aphids infest tender twigs and foliage. The fruit flies (*Chatodacus* sp.) may sometimes infest ripe fruits.

Fruit

The Guava Capsid Bug (*Helopeltis antonii* Sign.)—This reddish-brown capsid bug with long legs and antennae is a common insect which damages tender twigs and especially tender and older fruits by puncturing them for sucking the plant sap. The punctures made by the beak of the bug on tender fruits results, in course of time as the fruit grows, into patches of dark brown scab-like blisters on the surface of the affected fruit. The area of these scales depends upon the intensity and number of punctures inflicted by the bugs. Sometimes, some of the fruits may be completely malformed and disfigured. From the nature of the injury, it is clear that even the slightest damage will seriously affect the market-value of the affected fruits. Even in orchards where a fairly heavy damage is noticed, it is very difficult to see and collect many bugs, and most of them will be hiding under leaves or in cool places of the trees. Both young ones and adults are responsible for the damage.

The damage due to the bug may be effectively controlled by the application of a 5% BHC. or 50% wettable BHC, (one lb. in 16 gals. of water) once when the blossoms begin to appear and again about 3 weeks after the first application.

The fruit flies (*Chactodacus* sp.), though seen attacking especially ripe fruits, are not serious pests on guava.

oliage and Twig

Among the insects coming under this group, the guava mealybug *Pulvinaria psidii* Gr.) is the most common and sometimes serious, infesting oots and leaves. In the younger stages, the insect is greenish, having a close semblance to the coffee green bug (*L. viride*) which is also sometimes seen gether with it, and when the insect becomes mature and begins to lay eggs, forms a white egg-sac of soft waxy secretion being its body, in which the ntire quota of eggs laid by a female are concealed. The young ones after tching from the eggs crawl out of the ovisac and attach themselves in itable places on tender portions of the plant and begin feeding by sucking p. A heavily infested plant exhibits a large number of these conspicuous, hite, ovisacs on the leaves (particularly lower surface) and anywhere on the vigs and even bigger branches. The 'honey dew' secreted by these insects tracts the black fungus and the foliage and twigs may appear black due to e fungus.

There are a good number of natural enemies upon this mealybug, which eep the pest normally under check. These natural agents are mostly various ecies of lady-bird beetles. Sometimes, inspite of these natural enemies, the est becomes serious and control by some other means becomes necessary. It rather difficult to effectively control the mealybug with the common secticides. 2-3 sprays of Fish oil rosin soap (one lb. in 4 gals. of water) plied at intervals of 2 weeks, gives good relief.

The other insects that are sometimes noted on the foliage and twigs are e Coffee green-bug (*L. viride*) mentioned above and plant-lice (aphids). oth these species are not noticed to assume a pest-form.

PLANTAIN

The only insect that has been noted as a pest, and a minor one, is the antain sucker-borer (*Coomopolites sordidus* Germar), the grubs of which ore into the root-stock of plantain. The dirty whitish grubs, and whitish upae and even the adults which are dark-brown in colour measuring about inch in length, are found inside the infested root-portion when it is opened. ften it is not possible to make out the attack by this weevil, as the plant does ot exhibit any marked external symptoms of attack. In cases of severe festation the entire root may be riddled and the plant appears sickly and nally dies. In rare cases, the grubs may tunnel up the central portion of the em a little above the ground-level, in which case, the central shoot dries up, dicating the upward migration of the grubs in the stem.

It is very difficult to check the infestations of this insect, as most of the fe stages are spent in the plant tissue within the soil. The affected portions the root should be removed completely and burnt. Only healthy root stock ould be selected for planting purposes.

JACK (*Artocarpus integrifolia*)

This plant suffers little due to insect pests and they are mainly the shoot nd fruit borer (*Margaronia caesalis* W.) and the spittle bug (*Cosmoscarta lata* Dist.) Both the species are occasionally seen and in a mild form. he adult of the fruit borer is a whitish-brown moth, the pink caterpillar which bore into tender shoots and developing fruits. The young ones the spittle bug live in small groups, each colony in a white frothy mass. hese frothy masses are seen upon tender shoots and stalks of ripening fruits nd these fruits may drop off prematurely.

POMEGRANATE (Punica granatum)

This crop suffers regularly from the attacks of the fruit borer, *Virachola isocrates* Fabr. The adult is a bluish brown butterfly. Besides pomegranate which is its main host, this insect may sometimes attack the fruits of guava peach, apple, etc.

Whitish eggs are laid singly on the flowers or on the surface of tender fruits. The caterpillar on hatching bores a hole into the fruit and tunnels into it feeding on the inner contents. The full grown caterpillar is a dirty, dark brown, short and stout larva measuring about $\frac{3}{4}$ inch in length. Pupation takes place either inside the fruit or upon the fruit-stalks. The bored fruit shows a hole through which excreta of the larva inside is being thrown out.

It is very difficult to control this fruit-borer. The affected fruits may be removed and destroyed. Costly varieties of fruits may be protected to a certain extent from the attack of this borer by enclosing fruits even from the beginning with muslin bags or loosely hanging bamboo-spheres.

Infesting the twigs and foliage are certain insects, like the leaf-eating tusoock caterpillar (*Euproctio fraterna* Mo.) and a few sucking insects, like the aphids and mealybugs. None of these insects have been seen to assume a pest-form.

FIG

The fig mite (*Eriophyes* sp.) is often seen on the leaves, especially on the lower surfaces living in large colonies and the affected portion gradually turns brown and finally dries up. If the infested leaf is examined under a binocular microscope, thousands of minute yellowish, elongate mites are made out. This is often a serious pest, and if not promptly checked may defoliate the entire plant.

The mite-pest can be successfully controlled either by dusting fine sulphur (flowers of sulphur) mixed with woodash (1 : 6) or by spraying dilute solution of lime-sulphur.

The other insects that are seen sometimes on fig are the stem borer (*Batocera rufomaculata* De Geer), the larva boring into the stem; the stem girdler (*Sthenias grisator* Fabr.), and the leaf-eating caterpillars (*Hypsa* sp. and *Phycodes radiata* Ochs.). These insects are of little importance, as they are occasionally seen and in a mild form.

GRAPE VINE

The most common insect that appears on grape-vine is the flea beetle (*Scelodonta strigicollis* Mots.). The adult is a small active shining brown beetle, about 1/3 inch long and feeds voraciously on tender shoots and leaves. It is particularly active in its feeding after dusk and early in the morning. Sometimes it causes substantial damage to foliage and tender twigs.

The beetle pest is successfully controlled by dusting BHC. 5% preferably in the evenings, just after fresh flush of foliage is put up on the vines. The beetles are also easily dislodged into a wide pan containing water with a little kerosene oil and thus killed.

The grape berry borer (*Oxyptilus regulus* Meyr.) is a dark, small plume moth, the caterpillar of which is occasionally seen boring into fruit and feeding on the contents. It has not been observed to be a pest so far. Dusting fruit with pyrethrum powder mixed with wood ash (1 : 4) gives good relief against this pest.

IN HOT AND STEAMING UTTARA EVEN THE PLOUGH BULLOCKS WILL DRAG YOU TO WATER.

APPLE

Occasionally an ashy-grey weevil is noticed to feed on leaves, and in bad ases of infestation, the entire foliage may be eaten up. Rarely a cockchafer eetle is also found feeding on the foliage. These insects are controlled by the pplication of BHC. 5% dust, or by spraying calcium arsenate, if there are no uits, preferably in the evenings.

OST-WAR INSECTICIDES—THEIR USES AND LIMITATIONS—SPRAYING AND DUSTING EQUIPMENT—THEIR USES AND MAINTENANCE

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The new synthetic organic insecticides that have appeared on the market re the chlorinated hydrocarbons and the phosphorous compounds. The hlorinated hydrocarbons include (1) dichloro-di-phenyl-trichloroethane or DDT, (2) dichloro-diphenyl-dichloroethane or DDD. (3) methoxy chlor, he methoxy analog of DDT. (4) hexa chloro-cyclohexane (benzene hexa-hloride) or BHC. (5) the pure gamma isomer of benzene hexachloride or ndane, (6) chlordane and (7) chlorinated camphene or toxaphene. The hosphorous compounds include (1) tetraethyl pyrophosphate or TEPP, 2) hexaethyl tetraphosphate or HETP and (3) the thio phosphate compound r parathion.

DDT. is generally obtainable for plant protection in the form or wettable owders, dusts, emulsions and ordinary solutions. Technical DDT. is a cream o grey powder having fruitish odour. It is chiefly a nerve poison and kills y contact. It may act as a stomach poison also. Under the field conditions he spray deposits of DDT. decompose gradually losing toxicity in high emperatures and sunlight. Most of wettable powders contain not less than 0 per cent technical DDT. by weight. Wettable powders are largely used in praying fruit trees and vegetable plants. Dusts contain 1-50 per cent of echnical DDT. Pyrophyllite, talc and sometimes sulphur are used as arriers or diluents. Sulphur-DDT. may be either mechanical mixture of ulphur and DDT. or a fused mixture. Mostly 3 to 5 per cent DDT. dusts are sed effectively against vegetable insects as cabbage worms, tomato fruit vorms, thrips, flea beetles and others. Emulsible solution of DDT. contains solvent, DDT. and an emulsifier. These solutions are used in spraying ruit trees and shrubs. Milky emulsion is formed when solution is added o water. The solutions without emulsifier are ordinary solutions which are ntended for application as vapour, mist or fog. Solvents include kerosene, ght oil, xylene, toluene, carbon tetrachloride and methyl naphthalenes.

Rhothane, a product of the Rohm and Haas Company is an example for ichloro-diphenyl-dichloroethane or DDD. This insecticide is available in a vettable powder containing 50 per cent DDD and in a solution containing 5 per cent DDD. In experimental tests Rhothane has given good control f tomato insects, cabbage worms, leaf hoppers, flea beetles, aphis on peas, roundnut, *avare*, brinjal and cow-pea, mealy bugs on brinjal and epilachna rubs on potato. This is said to be less toxic than DDT to warm-blooded nimals.

The chlorinated compound which is being used on fruits and vegetable is methoxychlor or the methoxy analog of DDT. which has been designated as "Marlate" by its originators, the Du Pont Company of Wilmington, Delaware. Dimethoxy-diphenyl - trichloroethane is the active ingredient in this preparation. A wettable powder containing 50 per cent active ingredient is used as sprays on fruits and vegetables. This is said to be more effective than arsenical insecticides against many chewing insects but usually less effective than DDT.

Hexachlorocyclohexane (benzene hexachloride) is a volatile product having disagreeable odour. It is practically insoluble in water but is soluble in organic solvents. It is mainly a contact poison. It also acts as fumigant and stomach poison. Due to volatality of the gamma isomer which forms the insecticidal component the residual effect of the spray or dust deposit is short. The gamma isomer of a purity of more than 99 per cent is designated as 'Lindane'. Lindane is a white crystalline substance being relatively free from the objectionable features associated with unrefined benzene-hexachloride. It is stable in presence of acids but is broken down by lime and other alkaline substances. It is effectively used for the control of flies in dairy barns. It is not generally recommended on fruits and on vegetables because an objectionable flavour may be imparted to the edible portion of the crop.

Chlordane is chiefly a contact poison. It also acts as a stomach poison and fumigant. In the refined state it is a viscous nearly odourless liquid having a pale amber colour. The technical product contains 60 to 75 per cent chlordane. It is soluble in organic solvents but insoluble in water. Alkaline substances such as lime destroy its toxicity to insects. Its residual action for controlling insects is said to be longer than BHC but not equal to DDT. It is formulated as a solution, or emulsion, a wettable powder, or as dust for insecticidal use on agricultural crops. Aphids, cabbage looper, cabbage maggot, chinch bugs, potato beetles, cotton boll weevil, cotton boll worm, cotton leafworm, cucumber beetle, flea beetle, grass hoppers, stink bugs and wireworms, such dooryard and household pests as ants, bed bugs, fleas, cockroaches and weevils can be controlled.

Technical grade of chlorinated camphene or Toxaphene is a cream waxlike solid having a mild odour of pine. It is soluble in many organic solvents but it is not soluble in water, It acts as a contact insecticide and stomach poison. Insect pests of cotton may be controlled by Toxaphene.

On account of their low cost as compared to other insecticides like arsenicals, etc., their efficiency in insecticidal activity on a wider range of pests and their ready availability in the market, these chlorinated hydrocarbons are being used to a large extent in the control of insect pests by raiyats.

Heptachlor, Dieldrin and Aldrin are other chlorinated insecticides the places of which in controlling insect pests have yet to be determined.

Hexaethyl tetraphosphate or HETP is an amber coloured liquid. The technical product is a mixture of organic phosphates. HETP is miscible with water but is not soluble in kerosene. It is hygroscopic and rapidly hydrolises into products which are of no insecticidal value. When diluted for spraying it should be used within one or two hours after being diluted. It is effective against aphids and mites.

Tetraethyl pyrophosphate or TEPP is similar to Hexaethyl-tetraphosphate in its properties. This is said to be more toxic to warm-blooded animals and

insects than HETP. Persons handling undiluted material should avoid ontact with the skin or prolonged contact with the dilute spray solution. Tites and locusts are effectively controlled by TEPP.

The Thiophosphate compound or parathion was prepared under the code ame of E. 605. This is a deep brown to yellow liquid which is soluble in ater and is insoluble in kerosene. It is moderately volatile and after several ays the spray or dust deposits lose toxicity to insects. It may act as stomach oison, contact insecticide or fumigant. It is extremely dangerous if vallowed, inhaled or absorbed through the skin. Therefore it should not be andled without taking proper safety measures. Parathion is effective in ontrolling the common vegetable and garden pests such as aphis of different ecies including *Macrosiphum pisi* Kalt, on peas, *Crocidolomia binotalis* ell *Bagrada picta*, *Orthezia insignis* Dong, *Lecanium* species on sapota.

The possibility of a large scale use of the phosphorous compounds is still eing studied on account of the injurious nature of the chemicals to man and imals.

For the efficient application of chemicals in plant protection, proper uipment is necessary. The ideal requirement for equipment is to make ossible an even, thorough coverage of the plants or crops at the right time with e minimum time, labour and material. Many different spraying and dusting achines are available according to the needs of agriculturists. These achines may be either hand-operated or power-driven.

The purpose of spraying equipment is to allow the insecticides in the rm of finely divided droplets so that they may be deposited evenly on the ants or pests. Hand atomizer is the smallest type of hand sprayer consisting an air-compressing pump attached to a small tank or reservoir. The pacity of the reservoir varies from one pint to a gallon. It is useful when nall areas are to be treated.

Bucket or Stirrup pump is very light and easily handled. It develops fficient pressure to spray bushes and low trees. It consists of a single or uble-acting pump which can be clamped or set into any ordinary bucket. he bucket forms the reservoir for the spray.

Knapsack sprayer is useful in small gardens and where a few trees and rubs of small height are to be sprayed. A uniform pressure can be main-ined by keeping the pump in operation. It is equipped with straps and is rried on the back of the operator. Compression sprayer is made to hold 2 to gallons of spray and in general it has the same uses as knapsack sprayer.

Wheel-barrow and Barrel sprayers are equipped with 10 to 50 gallon nks in which large and powerful pumps similar to bucket pumps are placed. hey are of different designs adaptable for spraying shrubs small orchards and rge vegetable gardens.

For treating large acreages portable power sprayers, stationary plants and r-planes are used. These are power-driven and are convenient to discharge e work more quickly and efficiently. But they are more expensive than hand-perated equipment.

Dusters make use of air stream to carry chemicals in finely divided and y form on to the plants. Hand dusters are of different types. The simplest nd duster is a sack, cheese cloth bag or a bucket or a can with holes in the ttom from which the dust can be shaken on to the plants. The plunger

type, the bellows type and the fan type of hand dusters are adapted for use treating vegetable or truck crops or small trees.

Power dusters, Air-plane and Helicopter dusters which are power-driv machines are used in dusting large areas.

The following practices will help keeping the appliances in good runnin order. At the beginning of the season, replace worn out parts if necessar Before the work at each time all working parts should be lubricated. Sprayin material should always be added in the tank through the strainer to preve valve trouble and nozzle clogging. At the close of the work wash the tan carefully and run clear water through the pump, hose and spray nozzle for minute or two. This prevents corrosion of parts and valve sticking when th sprayer is used again. Clean external parts of sprayer to remove spray resid that may produce corrosion. At the end of the season clean sprayer thoroughl drain all water from the engine, pump and tank; disconnect the hose lubricate all external working parts, spray gun and nozzle parts thoroughly coat with heavy oil or grease all parts subject to rusting; store hose aft completely draining it.

Similar treatment for lubrication of working parts and protection fro corrosion should be given to dusting equipment when being used or bei prepared for storage.

INSECTICIDES OF VEGETABLE ORIGIN: A SHORT NOTE

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The use of chemical poisons like nicotine sulphate and arsenates in t control of insect pests on agricultural and horticultural crops is attended wi certain disadvantages. These are highly poisonous to human beings a domestic animals and have to be handled with extreme care and cautio They leave behind a poisonous residue which in the case of fruits and veg tables have to be carefully removed by washing or other means. This is often very tedious business. These drawbacks led to an intensive search alternative sources of insecticides, which are relatively harmless to high forms of life while being lethal to insects in minute doses. As a result of t work of scientists of many nations a new class of contact insecticides,-i those that kill insects by mere external contact, were discovered. These a derived from certain plants, both cultivated and wild, of which pyrethrum a a group of leguminous plants known as fish poisons are the most important.

Pyrethrum: Pyrethrum is a plant closely related to crysanthemums a contains in its flowers, two powerful insecticides, known respectively pyrethrin I and pyrethrin II. When powdered pyrethrum flowers or extra containing the pyrethrins are dusted or sprayed on insects, they produce immediate knock out effect, that is to say the insects are instantly paraly and die a little while later.

Pyrethrum is a cultivated plant. It thrives best at attitudes varying fr 5,000—9,000 feet, the yield of flowers being more at higher elevations. It c be propagated either by seed or by means of slips, the latter being the meth generally employed. The flowers, which are white, should be harvested wh they are just open, only the flower heads being picked leaving the st behind. The flowers heads are then dried, graded and baled. The qual

f pyrethrum flowers is judged by its total pyrethrin contents which in good rades varies from 1.3 to 1.5% on dry weight of flowers. Individual lots may ave as high as 2% of pyrethrins.

The chief countries for commercial production of pyrethrum are Japan, Kenya, Iran and some countries of south-east Europe. Pyrethrum has been ntroduced recently into India and has been found to do well in Kashmir, Assam, the Nilgiris and Mysore. The quality of flowers grown in Mysore is quite good.

A kerosene extract of pyrethrum flowers is used extensively as an nti-malarial spray in the control of mosquitoes. The powdered flowers or their xtract enter into the composition of several proprietary preparations used as nsecticides in agriculture and in household sprays against house flies and ther noxious insects.

Fish poison plants: These are plants commonly used in tropical ountries for stupefying fish and belong mainly to the natural order, Leguminosae. They are distributed widely in the tropical and semi-tropical elt, in Indonesia, Malaya, India, East and Central Africa and tropical America. While quite a large number of plants of this group contain in their oots, leaves, etc., variable amounts of insecticides, those that are of commercial mportance are mainly *Derris elliptica*, certain species of *Lonchocarpus*, and a ew species of *Tephrosia*. The last named are, for the most part, of local mportance in the countries of their occurrence.

Derris elliptica; This plant occurs chiefly in Malaya, Indochina and ndonesia but is also reported in other countries in the tropical belt. It does ot occur in India but has been introduced from Malaya. After its commercial ossibilities as an insecticide became known, several other countries have taken n interest in its cultivation. The chief toxic constituent is rotenone, but ther associated substances similar in structure and properties to rotenone, ontribute to its total effectiveness as an insecticide. The rotenone content f Derris in the wild state is low varying from 0.2 to 5% on dry roots. The Derris of commerce comes entirely from the cultivated plant, which are rown from strains that have been specially selected for their high rotenone ontent. These have been further improved by clonal selection. Some of hese have a rotenone content as high as 12%.

Derris elliptica grows well on sandy soils under a moist and warm limate. Propagation is by stem cuttings, which should be established in nurseries before the rains and the rooted cuttings are transplanted during the ains. The roots can be harvested when the plants are 18-20 months old. Smaller roots contain more of the active substances than thick roots, and in ommercial practice, roots bigger than pencil size are rejected. Commercial valuation is based on the rotenone content of the roots and the total either extractives, *i.e.*, the resin that can be extracted from the roots. Commercial grades contain 6-8% of rotenone.

Derris root is used both in the form of dusts and as emulsions containing xtracts of the roots. It may be used by itself or mixed with other insecticides ike pyrethrum or diluted with inert material like Kieselgur.

Aqueous extracts of roots, soaked over night and ground to pulp are aluable in the control of pests in home gardens.

Some other species of Derris like *Derris malacconsis*, *Derris uligenosa* are also used to a lesser extent. Several species of Derris occur in different parts of India but their rotenone content is very poor.

Lonchocarpus Species: While these occur in many countries, their commercial exploitation as insecticides is confined mainly to Peru and Brazil, where strains with high toxic contents occur wild. The active principles are the same as in Derris, namely rotenone and associated compounds. But the proportion of rotenone to other constituents is lower than in Derris and bulk for bulk, these roots are less effective than Derris. The usual rotenone content is 2-3% though samples with 12-15% are reported.

Tephrosia species: Compared to Derris and Lonchocarpus these are minor significance. The most important tephrosia species as insecticides, are *T. marcopoda*, *T. berginiana*: *T. villosa* and *T. vogelii* occurs wild in East Africa and the leaves are a source of insecticide of local importance.

In Mysore, *T. candida* seeds have been found to possess considerable insecticidal power.

Investigations in Mysore: Investigations in Mysore, on vegetable insecticides were started about 1930 and several local fish poison plants were examined. The seeds of *Pongania glabra* (Hongay) were found to possess toxicity to sucking insects and the active principle was associated with the oil of the seed. A soap based on Hongey oil, called *Hongey resin soap* was prepared and placed on the market, which has largely replaced *fish oil resin soaps* in the control of mealy bugs, green bugs and aphids and other sucking insects.

The I.C.A.R. made a grant in 1933 for research on fish poison in Mysore and under this Scheme over 100 locally available plants, including both legumes and other types were examined. Of these the following were found to possess considerable insecticidal value.

1. Stem bark of *Mundulea suberosa*. *Mundulea suberosa* is a small tree growing in the shrub jungle of Hassan and Tumkur districts. The outer bark of the stem of this plant is a recognised local fish poison, the plant being known as *Meenu Mari*, which literaliy means fish killer.

While mundulea bark in other countries is reported to contain *rotenone* specimens examined in Mysore did not have any. The activity of the bark was found to be due to a crystalline compouud, which has been isolated in pure form and some of its properties studied.

For use as an insecticide, an alcoholic extract of the bark can be used. The bark is powdered, extracted with boiling water and the residue after drying is extracted with hot Ethyl alcohol. On concentrating this extract, a semi solid resinous mass possessing all the activity of the original bark is obtained. When required for use this can be redissolved in a little alcohol, and diluted with water. A stable suspension suitable to spraying is obtained. This is effective against grass-hoppers, caterpillars on cabbages and other vegetables, certain hairy caterpillars and on soft bodied sucking insects and on epilachna grubs on potatoes.

The powdered bark gives good control over pests of stored grains.

An aqueous extract of the powder at concentrations of 20% is an effective spray against *mango-hopper*.

2. *Tephrosia candida*: This is cultivated as a green manure in tea estaes and the seeds have at present no commercial value. On examination the seeds were found to contain traces of rotenone. An alcoholic extract of the seeds possesses a high degree of insecticidal activity. The insecticide

re form has not yet been isolated but a highly concentrated extract possess- all the activity of the original seeds has been obtained. For use as an ecticide, an alcoholic extract prepared in the same way as with Mundulea k can be used. The extract is a thick liquid, which keeps without deteri- tion and mixes with water in all proportions forming a stable emulsion. e extract is effective against caterpillars on fruits and vegetables, mealy gs and other soft bodied insects and on epilachna-potatoes. At equivalent ncentration, the extract from tephrosia seeds is twice as active as the extract m Mundulea stem bark.

The commercial exploitation of these two products seems a worthwhile dertaking, The preparation of the active extract offers no special problem technology and as the extracts keep well and form emulsions, they are likely find a good market.

Derris elliptica : A few cuttings of *Derris elliptica* were obtained from laya and propagated in Bangalore, and the stock at Bangalore was utilised grow it at Visweswariah Canal Farm, and Balehonnur Farm. The plant ows luxuriantily under Mysore conditions and yield of root is about $\frac{3}{4}$ lb. per sh which compares favourably with yields elsewhere.

The *rotenone* content of the roots is high, the average being 7% and the er extract nearly 22% indicating that the quality of root is quite good.

This is a very useful plant and if properly exploited is likely to pay good idends. Planting material is avaialable at V. C. Farm and can be supplied interested cultivators.

The recent introduction of synthetic chemicals of the DDT. class as ntact insecticides and their quick success and popularity naturally raises the estion of the future of Derris and other related plants as sources of ecticides. These synthetic chemicals have yet to stand the test of time and ablish their superiority over vegetable products. It is already being re- gnised that resistant strains of flies, mosquitoes, etc., have become established places where the use of synthetic chemicals have been adopted while no ch trouble has so far been encountered with pyrethrum, derris, etc. For a g time to come at any rate, these vegetable products have an important e to play.

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THE ROLE OF LEGUMINOUS CROPS IN AGRICULTURE

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Leguminous crops play an important role in agriculture as they do in man and animal nutrition. Legumiuous crops, among which are the pulses rich in the nitrogen containing food constituent, protein. Proteins are the

important components of animal flesh and the proteins of plants are a essential source for production of the tissues of animal and human livin matter. The organic matter of soils termed humus contains in it a good pa of nitrogen in a combined form and this serves as food and energy material f the micro-organisms that inhabit soil and which are essential for mainte ance of soil fertility.

In our country we have a wide variety of leguminous crops which ser to maintain and to build up the fertility of soils by adding the essential pla nutrient element nitrogen and also serving as edible proteins which are an in portant part of animal and human diet. Where these crops are used f benefitting the soil directly, they are referred to as green manure crops a when these are used as food for humans they are referred to as pulses. Bo these types of crops help to benefit the soil, though by different metho *Togari*, *avare*, cowpea, blackgram, greengram, horsegram and related cr are familiar pulse crops which while serving directly as food for animal li serve also, indirectly as food for the soil by supplying in large quantities, of ganic matter and nitrogen. Other leguminous non-edible plants like sunnhem *dhaincha*, *berseem*, *hongey*, *thangadi*, wild indigo and others serve to bene the soil more directly by supplying green matter which is rich in soil revivi organic matter and nitrogen, besides other plant nutrients.

The chief value of legumes as enrichers of soil lies in their capacity utilise the unlimited supplies of nitrogen present in the atmosphere, throu the intermediary of micro-organisms that specially inhabit their root nodu and convert gaseous nitrogen, useless as such to plants, into forms which useful both to the soil and the plants alike. Leguminous crops are usua equipped with an extensive and deep root system unlike most cereals and he are able to utilise the mineral elements present in soil from deeper and differ layers than those in which the cereal root system operates. The existence an elaborate underground root system has a binding effect upon the particles, which while promoting a proper physical structure in these partic prevents their wash off through erosion. The decomposition of the r after the crop is matured and harvested, adds a considerable amount organic matter and nitrogen to the soil thus having a beneficial effect on succeeding crop.

The above advantages derived from the growth of leguminous crops used to best advantage in agriculture in the following two ways : (1) In gro leguminous crops and using them in an immature stage directly as manu and (2) In raising leguminous crops of the type of pulses either singly o inter crops with cereals and deriving the multiple benefit of enriching the improving the yield and quality of the inter crop and obtaining a pulse w is valuable as a food.

(i) Leguminous Crops as green manures

A variety of plants are used for green manuring. The best known of t are sunnhemp, *dhaincha*, *berseem*, horsegram and *glyricidia*. Besides these a large number of plants known best by their botanical names like, *Crotal striata*, *Crotalaria anagyroides*, *Sesbania speciosa*, *Tephrosia candida*, A number of non-legumes like gingelly, *huchellu*, sunflower, maize and j are also raised for green manuring purposes. These supply only org matter in abundance to the soil, while leguminous plants supply both org matter and nitrogen. A good crop of sunnhemp or *dhaincha*, which rapidly and yield 3 to 5,000 lbs. of green matter per acre after only 6 weeks growth will add 30 to 50 lbs. of nitrogen to the soil on being tu

der. When ploughed under just at flowering time when the plants are green d succulent, they decompose quickly under moist soil and form an excellent anure.

Application of phosphates to green manure crops is found to make a lot of ference in the growth and composition of the crop. Phosphates which are not sily taken up by the shallow rooted cereals are quickly absorbed by leguminous ops which are particularly strong feeders on this plant nutrient and the growth the plants is also enhanced. With phosphate applied at the rate of half to cwt. of superphosphate, the green matter yield is found to increase from 50 to 0 per cent under optimum conditions and the phosphate absorbed by this crop also larger by 20 to 30%. When such a crop is used as green manure, the osphate is found to be taken up quite easily by the succeeding cereal ops. This effect is found to be due to prevention of "fixation" of the added osphate by soil minerals through the conversion of the phosphate applied iginally in the mineral form, into forms in organic combination. The ganic phosphorus in the green matter as it undergoes decomposition is adually released in a mineral form and thereby loss through "fixation" is nimised. A similar advantage is obtained by turning under the soil, green anure along with phosphatic fertilizers, where the fixation appears to be evented due to the acids and gases formed in the course of the active composition of the green matter.

i) Mixed cropping of legumes with cereals.

In areas where cropping is dependant on rainfall, usually there is only e cropping season and that during the monsoon period. During this season e ryot is constrained to grow both a cereal as well as a pulse crop, to meet s food requirements. Since a rotation of crops is not possible, both these pes of crops are raised simultaneously by the method of growing the legume an intercrop spacing it between the cereal to best advantage. Growing ops like *avare*, *togari*, etc., as "*akkadi*" crops with ragi and jola, is a miliar practice of the dry cultivation zones of the State. The types of crops own and the optimum spacing between rows of different crops is based more individual needs and practical experience rather than scientific experimen-n. Our work on mixed cropping during the past five years in both small d large scale trials indicates that when groundnut or soyabeans are grown th ragi in alternate rows the yield of each crop is improved compared to the elds obtained when they are grown separately as the pure crops. Ragi ems to benefit from the association with the legume, possibly by supply of trogen or other plant nutrients from the root regions of the legume and the gume in its turn is benefited by the availability of more space and less owding of a similar crop which is likely to restrict the availability of nutrient ements particularly needed by it. Such crop combinations besides enabling more thorough and rational exploitation by the crops of the soil nutrients, lps conservation of the top soil, a serious menace in dry land cultivation, due provision of better surface cover.

Thus it is seen that legumes play a very useful role in agriculture pro-ding very inexpensive and natural methods of conserving the nutrients in the l and also enriching them through manuring. A wider and rational adapta-n of the multitude of leguminous plants available in the country to suit fferent conditions of cultivation and cropping will enable our ryot to maintain d to improve the productivity of not only irrigated lands but also the dry nds which form the bulk of the cultivable lands of the State.

For equivalents of local names please see the last article.—ED.

THE ROLE OF TRACE ELEMENTS IN PLANT NUTRITION.

THEIR INFLUENCE ON PRODUCTION OF RAGI AND PADDY

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Till the beginning of this century it was believed that plants require for their growth only the elements nitrogen, phosphorus and potash. But with the development of accurate methods of chemical analysis and experimentation it is found that a larger number of mineral elements are essential for the normal growth of plants, than was previously supposed. Plants in general are found to need about a dozen elements for healthy growth and these are referred to as the essential elements of plant nutrition. These may be grouped into (a) the major elements consisting of nitrogen, phosphorus and potassium ; (b) the secondary elements like magnesium, calcium and sulphur, and (c) the "minor" or "trace" elements consisting of boron, zinc, manganese, copper, iron and molybdenum. This last group is needed only in very low concentrations varying from half to 500 parts per million. The terms major and minor elements are not to be taken as referring to the relative value of these elements to the plants since all are essential, but only as indicating the relative quantities needed by the plant. The terms "trace elements" would seem to be better than minor elements in indicating their role in plant life.

The relation of trace elements to the nutrition of the various common crops has not so far been studied in India to anything like the same extent that the major elements nitrogen, phosphorus and potassium have been studied. The technique involved in estimating the content of these elements in soils and crops are intricate and requires special reagents and equipment which has been beyond the scope of work of the ordinary laboratories and this has acted as a deterrent to more common or routine analysis for their content.

In contrast to laboratory analytical methods, a study of the response of crops to the trace elements, either to their withdrawal from nutrient solutions supplied for their growth in culture solutions or their supply to crops grown on different soils under different conditions, is much easier. Hence it is on such lines that work in this country has largely progressed and these have yielded sufficiently useful information to judge whether a particuiar crop reacts to the absence of different trace elements or responds to their application under actual conditions of growth.

1. Influence of Zinc on Ragi

In Mysore State the first field experiments with trace elements were started during 1948, the crop being ragi. Zinc, copper and boron salts were tried both singly and in combinations. The first results from Hebbal Farm showed marked response of ragi to zinc treatment and not to the other elements. These experiments which were repeated in a number of centres revealed that an application of only 5 to 10 lbs. of zinc sulphate to the acre before sowing of the seeds, caused an increase in yield of $\frac{1}{2}$ to $1\frac{1}{2}$ pallas of ragi per acre and proportional increases in straw yields. Under irrigated conditions the increase in ragi yield by this treatment was more certain than in the crop raised under rain fed conditions.

Since application of such small quantities of zinc salts to the soil ffers from the disadvantage that their full effect is not felt by the crop owing disposal in the midst of a large bulk of the soil, it was considered that their ectiveness could be increased by bringing the salts in direct contact with the ds at or before the time of sowing. A method of achieving this, is to treat e seeds with solutions of the zinc salts in suitable concentration. Preliminary experiments indicated that over a wide range of concentrations, zinc salts l not affect germination of ragi seeds and that a quantity of 8 to 10% of the ts on the weight of the seeds were completely absorbed by the seeds through e seed coat, provided the quantity of solution used is just adequate to moisten e seeds. It was found from trials both on small scale plots and large fields at the seed treatments brought about increases in ragi yield of the same ler as that obtained with the soil treatment. Also it was found that the timum concentration of zinc salt required to produce satisfactory crop inases is about 1 to 2% on the weight of the seeds. A satisfactory method treating seeds with approximately this quantity of zinc salts is to dissolve *ola* by weight of zinc sulphate in $\frac{3}{4}$ *pavu* of water and to use this solution thoroughly moisten 1 *seer* of ragi seeds. The same proportion of t and solution are used for large quantities of seeds. On wetting with s quantity of solution, the salts are completely absorbed by the seeds ich after drying are ready for sowing either in nurseries or for being oadcast over the field. The cost of this treatment for a *seer* of ragi seed is rdly half an anna.

Analyses of the plants raised after treating the seeds indicate a larger ntent of zinc in the straw, the treated crop containing 35 parts per million of nc against only 25 p.p.m. in the untreated crop. The grain in both the ses, however showed the same content of zinc of about 4 parts per million.

2. Influence of Copper on Paddy

It has been found from nutrient culture studies that a deficiency of pper causes wilting in rice plants with marginal chlorosis of the young leaves. ain formation is also very much impaired. In contrast to ragi, the influence trace elements under field condition on paddy, which is the food crop next importance to ragi in the State, has not been so easy to determine. As th ragi, zinc, copper and boron salts were tried on this crop in field experints and from the results of a number of such experiments both statistically d out and in bulk plots, it is ascertained that application of copper sulphate the level of 5 lbs. per acre gives, in a large number of cases, 5 to 15% crease in yield of paddy grain and somewhat lower increases in yield of aw. Increasing the dosage of copper sulphate to 10 lbs. or over is not nd to cause consistent increases in yield, while the higher dose definitely press the yield and prove disadvantageous to the crop. A few typical results tained from field experiments at different Government farms are reproduced low and they show increases of paddy grain upto $1\frac{1}{2}$ pallas per acre with plications of 5 lbs. of copper sulphate to the field sometime before transntation. Bulk scale trials over 1 acre blocks have also confirmed these sults. As regards the economics of the treatment, 5 lbs. of copper sulphate st between Rs. 3 and 4 and the increase in yield more than covers this penditure.

Table showing the effect of Copper Sulphate on Paddy yields

Year of trial	Location	Copper sulphate used in lbs. per acre	Yield in lbs. per acre				Increase	
			Control		Treated with Copper sulphate			
			Grain	Straw	Grain	Straw	Grain	Straw
1949-50 ...	Hebbal	5	1,615	7,108	2,010	7,276	395	168
1950-51 ...	,,	5	1,597	3,384	1,800	3,533	303	149
,, ...	,,	10	1,597	3,384	1,552	3,855	45	471
,, ...	Nagenahalli	5	1,013	2,267	1,027	2,467	14	200
,, ...	,, (bulk)	5	2 068	3,574	2,880	4,815	820	1,241
,, ...	V. C. Farm	5	2,007	2,453	2,539	3,597	532	1,144
1952-53 ...	Nagenahalli	5	2,937	5,943	3,345	8,386	408	2,443
,, ...	V. C. Farm	5	2,392	2,928	2,608	2,944	216	16
,, ...	Hebbal	5	1,433	4,760	1,513	5,173	30	413

EFFECT OF HEAT, STORAGE AND OTHER FACTORS ON TH NUTRITIVE VALUE OF GHEE

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Ghee, the butterfat from cows and buffaloes milk, has been used as a article of diet from time immemorial. On analysis it is found to consist about twenty varieties of fatty acids in combination with glycerine. In add tion it contains 0.3 per cent of miscellaneous substances which are collective known as "unsaponifiable matter" consisting of valuable constituents li lecithin, cholesterol, carotene and vitamin A. Ghee provides energy to t body in a concentrated form. Compared with other edible fats like vegetab oils and *vanaspati*, the most outstanding characteristics of ghee are its delica aroma, appetising flavour and richness in vitamin A which is indicated by i natural yellow colour in the case of cow ghee. These empirical properties a in the long run correlated with the purity and quality of the product as judg by intricate scientific analysis.

Large bulk of the market ghee is prepared from butter obtained churning curds. It is, therefore to be expected that if care is not exercised properly processing the milk to be used for making curd, and if there is a negligence in the method of preparing curd and butter, defects which may developed at these initial stages will be incorporated in ghee and no amou of care at a later stage would help to improve the final product. Any defe introduced in ghee helps in its further decomposition and lowering the stora life and nutritive quality.

One of the commonest defect in ghee is the development of free fat acids, that is, fatty acids which are combined with glycerine in ghee a separated. This is largely due to the action of micro-organisms which eas gain access into milk, curd and butter if certain elementary precautions a not observed. The main sources of these micro-organisms are milk itse atmosphere, vessels and the starter used for curdling milk. Raw milk obtained from animals is easily contaminated by the micro-organisms alwa present in the atmosphere. If such milk is used direct, these orga isms bring about a variety of undesirable changes in milk by their acti

the various constituents present. The easiest way to eliminate the con-
nination is to boil milk. Mud pots which are often used for making and
urning curd should not only be properly cleaned but sterilised by boiling
ter for 10-15 minutes. Then milk should be seeded with a good starter.
e curd should be churned next day and the butter obtained washed twice
:h clean water. This should be melted into ghee preferably on the same day
l if not, at least within 3 days, the butter being stored under water during
interval. If these simple precautions are observed, ghee will have an
dity well below 0.5 per cent. In the market ghee samples it is too common
have as much as 3 to 5 per cent or more of free fatty acids which only
icates careless methods of production. The development of free fatty acids
ghee in itself is not harmful but it has been found that such high acid
:e contain 25 to 30 per cent less vitamin A. Vitamin A is a vital factor for
nan nutrition and every care should be taken to prevent its loss, as without
ghee does not differ much from other fats in its nutritive value. Ghee with
h acidity has a tendency to develop more acidity during storage and soon
ses its rich flavour and fetches lower price.

For melting butter into ghee, different temperatures are used depending
the taste of the consumers. Most suitable temperature of heating is about
°C. At this temperature ghee acquires a slightly cooked flavour liked by
ny. A rough indication of the correct temperature may be obtained by
icing the colour of the residue which settles to the bottom. The colour
uld be light brown. If lower temperature is used, care must be taken to
that all the moisture is properly eliminated so that the product contains
than about 0.5 per cent moisture. High moisture content helps in the
composition of ghee. For the same reason it is advisable not to first pre-
re *kachha* ghee, but heat butter straight to the final temperature. Heating
high temperatures is also harmful as ghee is found to lose its vitamin A
idly. It is also advisable not to use ghee for frying as the temperature
ained is too high and all the vitamin A is lost in no time.

Ghee absorbs oxygen rapidly from the atmosphere under favourable
ditions and develops off-flavour or rancidity. Ghee after it is made should
refore be kept in properly covered containers, and as far as possible, the
tainer should be full to keep as little air-gap as possible. The container
uld be stored in a cool place. Other factors which help in the development
off flavour are light and certain metals. Preparation of ghee should never
done in the open, or in strong sunlight. Very often during its preparation,
ee is kept in sunlight to help rapid filtration. Again, during the sale of
ter and ghee, these are kept in the front of the shop in strong light. Such
ctices are harmful. Due to the prevalence of such practices, it has been
en found that bazaar ghee hardly contain one-fourth the vitamin A content
good ghee. Certain metals also play an important role in accelerating the
duction of rancidity, the chief being iron, copper and alloys containing
per like brass and bronze. Ghee should be prepared in aluminium or
ned vessels, and stored in opaque vessels like new tins, aluminium or
celain jars. Ordinary mud pots often used for the purpose being porous
not allow ghee to be stored in good condition for more than 2 to 3 months.

The art of preparing good ghee and preserving its nutritive qualities is
difficult. The basic method is the same as followed in almost every
sehold. If in addition, a few simple precautions are observed as indicated
e, the nutritive quality and economic value of ghee could be considerably
anced.

THE FIELDS AFTER CHITTA RAINS ARE FINE; THE FISH FROM DRYING TANKS ARE FINE.

NUTRITIVE VALUE OF DAHI

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Dahi or curd in one form or the other is used daily in Indian households. Apart from its nutritive value, from very ancient times *dahi* has been looked upon as auspicious. Under our hot climatic conditions, *dahi* provides the cheapest means of preserving surplus milk, and utilizing economically such by-products as skim milk which would not be relished otherwise. Further production of *dahi* forms the first step in the preparation of several milk products, the most important of which are butter and ghee.

The composition of *dahi* varies with the type of milk used. If *dahi* is properly prepared, it has essentially the same composition as milk. It is a well balanced and almost complete food containing fat, proteins, sugar, minerals and vitamins. During the formation of *dahi*, nearly half of the milk sugar or lactose present in milk is converted into lactic acid. This, however, does not affect the overall nutritive value of milk. *Dahi* is formed by the action of certain micro-organisms which act on lactose and produce acidity which results in the curdling of milk. If *dahi* is prepared properly, that is, by using boiled and cooled milk inoculated with a good starter, the product retains all the nutritive value of original milk. In addition, the acid produced has a tendency to stabilize vitamin C which is otherwise easily oxidised if milk is stored as such. Depending on the type of culture used for preparing *dahi*, sometimes an increase in some of the water-soluble vitamins also occurs.

Amongst the most important properties of *dahi* is its easier digestibility compared to that of milk. It is estimated that only half the quantity of milk is digested in the time required for the digestian of *dahi*. Hence, *dahi* is specially suited for people with weak digestion as during illness. Many people are allergic to milk and are unable to make use of this most nutritious food. They could, however, utilize milk when given in the form of *dahi* without feeling any discomfort. *Dahi* increases the relish for other foods. It is known to relieve constipation and improve the absorption of bone forming minerals from foods. *Dahi* also inhibits to some extent the putrefractive action of micro-organisms in the intestines. However, too often it is assumed that mere conversion of milk into *dahi* will destroy all the harmful disease producing micro-organisms which may be present in milk. This is only partly correct and any destruction which may be brought about takes a long time, *i.e.* a much longer period than *dahi* would normally be stored. It is, therefore, important to properly boil the milk to be used for making *dahi* to ensure its nutritive value and also to give full scope for the activity of good organisms introduced with the starter which bring about only desirable changes free from putrefactive action. *Dahi* is not only a valuable food for adults but also for children. It has valuable therapeutic uses in diarrhoea in children, for treating infantile dyspepsia, constipation, and promoting healthy growth. *Dahi* has also been fed with good results to calves.

It is well-known that human intestines contain a large number of micro-organisms which by their activity help to supplement some of the vitamin requirements of the host. A more recent use of *dahi* is for the establishment of the normal microflora in the intestines which has been almost completely destroyed in persons treated with modern drugs containing antibiotics.

To derive maximum benefit from the valuable nutritional properties of *dahi*, it is essential to see that it is prepared under clean conditions. Good

ti has a compact appearance, smooth texture free from cracks and gas es, and has pleasant acidic flavour. It should be consumed in about hours after inoculating with the starter. If raw milk is used, or if the rter is of poor quality, the product obtained is full of gas holes accompanied the separation of whey and may be highly acidic. Such a product may : only be unpleasant to look at, but also loses its nutritive qualities due the breakdown by the micro-organisms of some of the milk constituents e proteins. The starter used should be selected with care. Good starter ltures are available at the Indian Dairy Research Institute, Bangalore. ter inoculating with the starter, the container should be properly covered d stored at a moderate temperature.

COMPOSITION AND NUTRITIVE VALUE OF FRESH AND HEATED MILK AND CURDS

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Freedom from disease, good health, fine physique, and virility in people hand in hand with a liberal intake of milk. Milk is the nearest approach to complete food because it supplies nearly all the many distinct materials eded by the body and which no other single foodstuff can supply.

Modern scientific research involving field experiments, nutrition surveys, d laboratory experiments which include chemical analysis and animal feeding, s entirely confirmed the empirical conclusions as to the nutritive value of ilk drawn previously from human experience.

Most of the sickness and disability associated with child bearing and the gh mortality rate among expectant mothers and new born babies can be bstantially reduced by improved diets which include a liberal supply of milk. uring pregnancy and lactation, the mother has not only to be supplied with the nutritional factors necessary for her own health, but has also to provide any essential substances for the development of the growing foetus and the ckling. These substances are adequately provided by sufficient amounts about 2 lbs. of milk.

The greatest emphasis should be laid on the nutrition of infants and owing children and many ill-effects result from deficient diet in infancy and ildhood. Some of these defects are not only serious but irreparable, even hen followed by adequate feeding in later life. Provision of sufficient amount milk—about 2 lbs. per child per day—can ensure good growth in children ho can later on develop into healthy citizens of this country.

An adult living on the typical rice or wheat diets of India, requires at ast 10 oz. of milk per day to balance his or her diet.

The high nutritive value of milk must be due to the different substances contains. Chemical analysis has shown that milk contains proteins, fat, rbohydrates, mineral salts and vitamins and of the last two, *viz.*, salts and tamins, almost all the factors essential for proper nutrition.

ilk Proteins

Proteins are the body builders and the main constituent of body tissues. ilk contains about 3.5 per cent of total proteins and of these about seven-ghths consists of casein, while lactalbumin and globulin constitute about one-ghth of the total. Milk proteins possess a high biological value, about 90

per cent being retained in the body. They contain all the ten essential amino acids which the human body cannot synthesize and which are indispensable for normal growth as well as for proper maintenance of the body. The author and his colleagues showed in 1939 that incorporation of small amounts of milk proteins causes a better utilisation of pulse proteins, the main source of proteins for vegetarians. Milk should therefore be an invariable constituent of the vegetarian diet.

Milk Sugar

Lactose is found in milk alone. The utilisation of calcium in a group of pre-school children has been found to increase in the presence of lactose. It is broken down only slowly in the intestine and some unchanged lactose reaches the large intestine. It is an excellent food for acid-forming bacteria and is used in acidophilus milk thereby to assist in the maintenance of these organisms in the colon, which is supposed to suppress the growth of putrefactive bacteria.

Milk Fat

The milk fat, known as butter fat or ghee, constitutes 4-5 per cent of milk of Indian cows and 6-8 per cent of buffalo milk. Besides supplying energy, the butterfat is the carrier of fat soluble vitamins in milk, the most important being the vitamin A (anti-xerophthalmic and growth promoting). The anti-rachitic vitamin D is also present in small amounts. Investigations carried out by the author show that butter-fat like other edible fats and oils is digested to the extent of 96-98 per cent by human beings. The butter-fat, however, is absorbed through the intestine at a rate faster than other fats and oils because of the presence of fatty acids of simple composition. The presence of an unknown growth factor in butter-fat has been reported.

Minerals in Milk

Much of the nutritive value of milk is due to the presence of the minerals and all the mineral elements of milk are essential for nutrition. Milk contains more calcium per unit of dry matter than most other foodstuffs. It has a special value to children as a source of calcium and phosphorus which two elements are the important constituents of bone.

The amounts of iron and iodine present in milk are very small. The infant's reserves of iron salts are usually exhausted before the sixth month and milk being deficient in iron, the addition to the diet of all infants, of small amounts of food rich in iron such as *purees* of green vegetables and carrots, or egg yolk, if tolerated, is recommended.

The Vitamins in Milk

The vitamins which are present in milk in sufficient amounts to make it a valuable source, are vitamin A and the heat stable members of the vitamin B complex, specially, riboflavin, nicotinic acid, pyridoxine, pantothenic acid and B_{12}. The other vitamins, *viz.* B_1, C, D and E are also present. The vitamin A in milk is associated with the butter-fat and is derived from carotene, the yellow colouring matter present in carrots, green leaves and greens. Cows convert only a part of the carotene in the fodder to vitamin A and secretes it into milk and they also secrete some unchanged carotene into milk. The total vitamin A activity of milk and butter-fat derived from cows is thus due to the combined action of carotene and vitamin A. Buffaloes and goats on the other hand secrete only vitamin A which is colourless, into the milk and no free carotene. That is why the ghee from cow's milk possesses a yellowish colour while the buffalo and goat ghee is practically colourless. The vitamin A activity of milk and butter-fat would thus depend on the feed and the season of the year which

some extent determines the amount of greens available. Ghee from cow, ıffalo and goat has practically the same vitamin A value although the goat ıd buffalo ghee is free from carotene and is colourless.

ow versus Goat, Buffalo and Human Milk

Some people are of the opinion that cow's milk is superior in nutritive alue to buffalo milk. The results of investigations carried out so far make us elieve that there is no scientific ground for such a belief. The buffalo milk eing richer in fat and total solids, would supply more energy and Vitamin A, r the same volume.

Because of its high fat content the buffalo milk might require some lution with water for infant feeding.

The goat milk is similar to cow's milk in the content of total solids, fats ıd other major constituents. It is poorer in riboflavin and B_{12} but richer nicotinic acid than cow's milk.

Human milk is poorer considerably in proteins and minerals, and slightly fat than cow's milk. The former however contains more lactose. In order, herefore, to humanise cow's milk, dilution to about double its volume and ddition of a little lactose is recommended. Human milk is richer in Vitamin C and has the additional advantage of not being subject to boiling hich destroys Vitamin C.

The composition of milk of different species in this country has been the ubject of intensive investigation at this Institute. The values for some f the constituents are given below :

THE COMPOSITION OF MILK

(*Average values per 100 ml. of milk*)

	Human	Cow	Buffalo	Goat
Water (g) ...	87.7	86.6	84.2	86.5
Total solids ,, ...	12.3	13.4	15.8[a]	13.5
Fat ,, ...	3 6	4.6	6.6[a]	4.5
Lactose ,, ...	6.8	4.9	5.2	4.7
Protein ,, ...	1.8	3.4	3.9	3 5
Ash ,, ...	0.08	0.68	0.70	0.77
Vitamin A (International Unit) ...	130[c]	90-200[b]	130-260[b]	85-200[b]
Vitamin B_1 (Thiamine) *mmg.* ...	18	49	50	43
Riboflavin ,, ...	56	150	107	75
Nicotinic acid ,, ...	172[c]	81	83	130
Vitamin B_{12} ,, ...	8	145	78	85
Vitamin C *mg.* ...	4.4[c]	2.5	2.8	3.5

N.B.—Other vitamins like D, E and C, biotin, choline, folic acid, inositol and pyrioxine are also present.

a. In certain parts of India specially in those where cotton seed is fed, the fat content f buffalo milk is higher, usually about 7-8 *g.* per 100 *ml.* and the total solids content is also orrespondingly high,

b. Depending on the season and amount of greens fed.

c. Values from foreign countries.

Pasteurisation and Boiling of Milk, Effect on Nutritive value

When milk is pasteurised or just boiled none of the proteins, lactose, fa or mineral matter is destroyed nor the utilisation of these constituents materially affected except that boiling makes a small fraction of the calcium o the milk insoluble. Vitamins A, D, E and the heat stable members of the vitamin B complex (riboflavin, nicotinic acid, pyridoxine and B_{12}) are unaffect ed. Pasteurisation destroys about 10-20 per cent of the thiamine while the loss on boiling is 20 per cent. Milk when pasteurised in contact with air loses about one-half of the ascorbic acid while 80 per cent of this vitamin is lost o boiling.

Effect of curd formation

Contrary to popular belief in this country, curds have not been foun superior to milk in nutritive value, Growth experiments on young rats carrie out at this Institute with milk or curds, supplemented with the minerals iron copper and manganese alone, show that rats on milk grew slightly better tha on curds. The thiamine, riboflavin and nicotinic acid content of curds pre pared with ordinary starters was generally found to be slightly less than that o milk. A few organisms can synthesize thiamine on curd formation. Vitamins A and C are not affected. The most outstanding change produced during cur formation is the decrease in lactose content by about 30-40 per cent in 24 hrs and formation of lactic acid which amounts to about 1-1.5 per cent in the curd The formation of the acid causes the precipitation of casein and the curdling During fermentation small amounts of volatile acids and traces of alcohol ar produced. The amount of soluble calcium and phosphorus goes up. While th total nitrogen remains unchanged during curd formation, protein nitroge decreases by about 5 per cent in 24 hrs. while non-protein and ammoni nitrogen increases.

Conclusion

The nutritive value of milk has been discussed in the preceding para graphs. All nutritionists agree upon its value in feeding of expectant an nursing mothers and of infants and growing children. Even in the case o adults it is difficult, although not impossible, to balance the diet without th inclusion of some milk. It is milk that mainly sustains us during periods o illness. But milk is in short supply in this country and until an adequa supply is available, what should be our policy in the distribution of milk ? Th vulnerable group of the population, the expectant and nursing mothers, an the infants and the growing children, should have the first claim on th available milk.

NUTRITIVE VALUE OF SOUTH INDIAN RICE DIETS AND EFFECT OF MILK AND OTHER SUPPLEMENTS

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Composition of Rice Diets in India

Rice is the staple food of more than half the population of the world a is thus the most important of all cereals. The daily diet of majority of t

ople in India specially in Assam, West Bengal, Bihar, Orissa, Madras, and ts of Central Provinces, Bombay, Hyderabad, Mysore, Travancore, Coorg, roda and Kashmir State (1, 2), is based on rice. The same is also true of people of Southern China and South-East Asia.

Numerous diet surveys carried out in different parts of India show that composition of the typical rice diets is much the same throughout the ntry. About 65-75 per cent, and sometimes even more, of the total calorie ake per day (2000-2500 calories), is derived from rice alone. In addition rice, the rice diet includes only small quantities of pulses, vegetables and oils. e intake of milk and milk products is generally negligible. Fish and, also at and eggs to some extent, are taken only in certain parts (Bengal, Assam, issa, Bihar and Malabar side) and among certain communities (non-ahmins in Madras, Mysore, Bombay) in the country. In South India the ly intake of rice varies generally from 12 to 15 oz., of pulses from 0.5 to oz., oils and fats from, to 1.5 oz. leafy vegetables from 1 to 3 oz., other getables from 1 to 5 oz. milk and milk products from 0 to 5 oz. fish, meat d eggs from 0.5 to 1.5 oz. fruit which is a rare ingredient from 0 to 2 oz. d condiments from 0 to 1 oz.

tritive value of Rice diets

The preponderance of carbohydrates in rice, and indeed in all cereals, licates that in order to get a balanced diet supplying adequate amounts of er nutrients, *viz*, proteins, fats, minerals and vitamins, rice must not be en alone or in a high proportion but along with considerable quantities of er foods richer in the latter ingredients. This is not the case with the rice diets India which contain such a high proportion of the cereal and are, therefore, vitably deficient in terms of the modern standards of the requirements of rious nutrients. Milling of rice and certain household practices like shing the rice before cooking and throwing away the cooking water cause a nsiderable loss of some very valuable constituents of rice and lower e nutritive value of rice diets still further.

Chemical and biological estimation of the different food constituents in e rice diet based on the analysis of rice and other foodstuffs in the diet, rnished some information about the quality of the diet. Besides, further owledge about the nutritive qualities of the rice diets has been obtained by :

1. Enquiring into the general level of health of rice eaters as compared th that of people accustomed to other diets.

2. Investigating the incidence of deficiency diseases like beri-beri, matitis, cheilosis, etc., among people taking rice diets.

3. Nutritive surveys among infants, children and mothers.

4. Study of the effect of feeding animals, specially rats, on typical e diets and of the results of various supplements to these diets.

5. Finding out the effect of giving supplementary foods to certain ups of population, specially children, living on rice diets.

6. Actual metabolism studies on human beings in order to find out ether adequate amounts of different nutrients are supplied by these diets.

emical analysis of Rice diets

Chemical analysis has revealed that rice diets contain only about 50-55 gm. vegetable proteins, very little of animal proteins, 8-10 gm. of fat, 500-550 gm.

of carbohydrates, 0.2—0.23 mg. calcuim 1.3—1.8 gm. phosphorus, about 300—400 I. U. of vitamin A, 500 microgram of thiamine, 0.2 mg. of riboflavin and 10 mg. of nicotinic acid. They suffer from a deficiency of calcium, from an unfavourable Ca : P ratio of 1 : 6 which interferes with the utilisation of calcium which is already inadequate, and also from a deficiency of fats, animal protein and vitamins A and C and B group of vitamins specially thiamine and riboflavin. The deficiency of vitamin B (thiamine) would depend on the processes to which rice has been subjected, *viz.*, milling, washing and the method of cooking. It has been reported (3) that milling of husked raw rice results in a loss of 76 per cent of thiamine, 56.6 per cent of riboflavin and 63.0 per cent of nicotinic acid. The effect of milling is to reduce the thiamine content of husked rice from 3-5 microgram to 1 microgram or even less per gm., and only 15 per cent of the thiamine present in milled rice remains after the rice has been washed and cooked by methods commonly used in India (4). Milling also reduces the content of other members of the vitamin B complex in rice. (5).

Enquiry into general level of health of the rice eater

Faulty and insufficient diet causes impairment of health and physical development leading to numerous forms of disease. Correct nutrition on the other hand ensures a high degree of general health and vitality and building of a strong and vigorous people. The infant, maternal and general mortality rates are higher and the expectation of life is lower among the majority of rice-eaters in India than among the people in Great Britain and America who are better fed. The physical development and working capacity of the people in those countries are also of a much higher level and the prevalence of diseases is much less. Although factors other than nutrition are concerned, there is no doubt that malnutrition of the rice-eaters and also of the wheat-eaters in certain classes of the population in India is mainly responsible for this state of affairs.

Prevalence of deficiency diseases

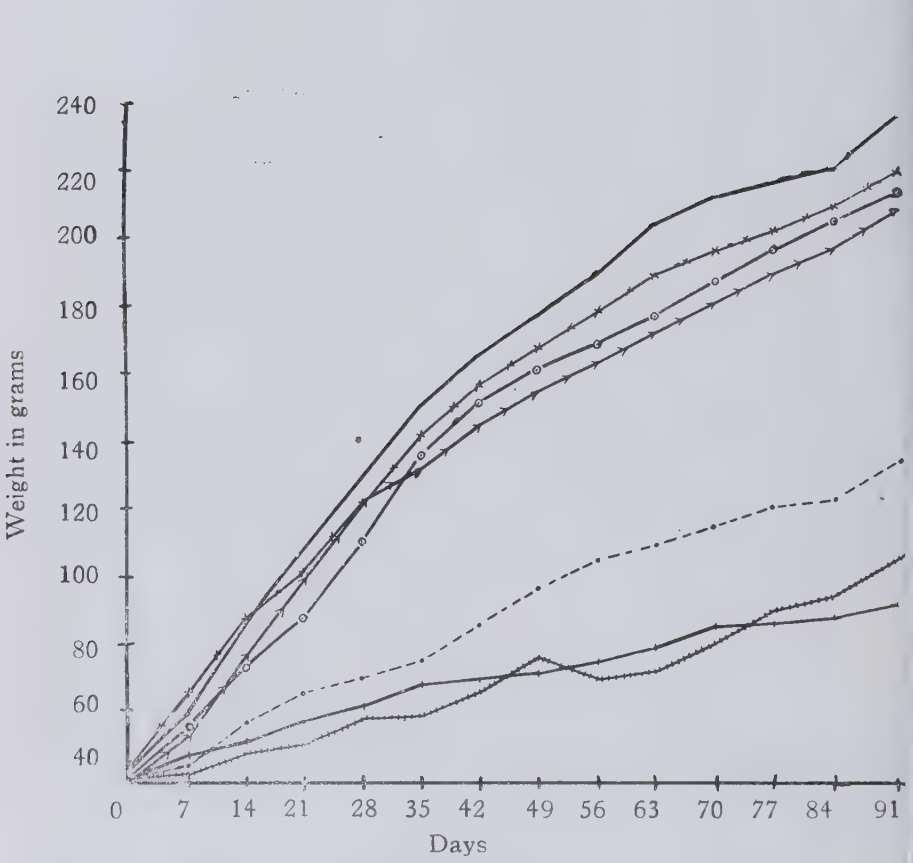
Investigation of the incidence of food deficiency diseases supplies more specific evidence of malnutrition. One of the best known deficiency diseases generally associated with rice-eating is beri-beri. The disease is still prevalent in Siam and parts of China, Malaya and also of India specially in the northern parts of Madras Presidency. Clinical conditions associated with riboflavin deficiency and keratomalacia, stomatitis cheilosis burning feet and hepatic cirrhosis are met more frequently among rice-eaters than among wheat-eating people in general.

Evaluation of Nutrition Status of Population Group

By the application of clinical, anthropometric, physiological and biochemical methods in the study of the nutrition status of groups of population specially infants, children and mothers, approximate assessment of the state of nutrition of the people is possible. Although not many systematic studies on this line have been carried out in India, such studies show the existence of extensive malnutrition among rice-eaters.

Results of feeding experiments on rats

In the well-known experiments of McCarrison (6) who fed groups of young rats on the typical diets of different parts of India, the rats on the South Indian and Bengali rice diets grew very slowly, at the rate of 3 to 4 gm. per week and could not attain the size and weight of rats fed on the Punjabi diet based on whole wheat supplemented by liberal amounts—about 20 oz of milk and vegetables. This showed that the typical rice diets of India were far from



Growth of male rats on South Indian diet + various supplements.

1. S. Indian diet only
2. Do + Butterfat
3. Do + „ + vitamins
4. Do + 10 ml. sheep milk
5. S. Indian diet + 10 ml. goat milk
6. „ Do + 10 ml. cow milk
7. Do + 10 ml. buffalo milk

ng balanced. Later investigations have verified the observation of Carrison. The Report of the Soya Bean Sub-Committee of the Indian search Fund Association (now known as the Indian Council of Medical search) (7) mentions the results of experiments on the growth of rats fed a typical rice diet of the common man in India and the same diet fortified calcium and vitamins. The effect of supplements of soyabean and other ses to the rice diet and the "fortified" rice diet was also studied. These dies were carried out at four different centres on the same plan. The ical rice diet caused very poor growth (0.75 to 3 gm. per week) in rats. e supplementation of pulses including soya bean led to some improvement gesting that pulses are useful supplements to poor rice diets. The addition calcium lactate and vitamins A & D (shark liver oil) and B vitamins ract of dried yeast) to the typical rice diet very considerably enhanced its wth-promoting properties for rats. The inclusion of pulses in the rtified" diet did not have any marked effect on growth. The Sub-mmittee, therefore, felt that in typical rice diets in India, lack of adequate ounts of calcium and vitamins was to a greater extent the limiting factor n the lack of protein. It must be mentioned that these diets were given *libitum* and there was adequate calorie intake in these experiments.

Aykroyd and Krishnan (8) also observed the beneficial effect of supple-nts like skimmed milk powder, dried yeast, calcium lactate and eggs on growth rate of rats fed on the typical rice diet previously used by Carrison. These authors also found that pulses, ground-nut, meat, fish, y vegetables or casein produced only a small improvement in the growth e while addition of extra fat in the form of gingelly oil did not accelerate wth. They also considered lack of calcium and B vitamins to be the main ciencies in the rice-eaters' diet. A few years back co-ordinated experiments e carried out at different Institutes in India under the auspices of Ministry Food of the Government of India on the effect of typical South Indian rice alone with various supplements like calcium carbonate, vitamins A, B mplex and D and also casein (containing sufficient amounts of calcium), on growth and reproductive ability of rats. This investigation which was ried out to see if hydrogenated vegetable (ground-nut) oil, m p 37° and C, had any deleterious effect, revealed that growth and reproductive and ating capacity of rats on the typical rice diet was very poor and that lusion and nature of the fat had no marked effect. The supplements, cially the vitamins, produced a beneficial effect on the growth and roduction. The results obtained at the Indian Dairy Research Institute are represented in the graph.

At this Institute, the effect of a daily supplement of 10 c.c. of milk (cow, falo, goat or sheep) on the rice diet was also observed. It will be seen that whole milk supplement to the rice diet caused the best growth which was ost identical with the growth obtained on the balanced adequate diet. The roductive and lactating capacity of rats on milk-supplemented rice s was also normal. Milk can thus supply all the missing factors in the ical rice-eaters' diet. The nature of the milk-cow, buffalo, goat or sheep pite of the differences in composition, specially in fat content in which falo and sheep milk is considerably richer containing 7-8 per cent of fat de very little difference. A human adult on rice diet would require a imum daily supplement of 10 oz. of milk to balance his diet and a supple-nt of about a pound of milk per day to make it almost optimum. For ancing the rice diets milk products like Curds, *Khoa*, *Kheer* and *Channa* as efficient as milk itself.

HAKA RAINS (NOV. 15—18) ARE LIKE THE *Pishacha's* (DEVIL'S) GRIP.

Feeding trials on children

Aykroyd and Krishnan (loc. cit.) also observed that school children gettin only the typical rice diet showed much less gain in weight and in height tha the group receiving in addition 8 oz. reconstituted skimmed milk. It obvious that the supplementary effect of whole milk which contains butter-fa and fat-soluble vitamins in addition will be still better. The famous exper ments of Corry Mann who in 1926 gave milk supplement to some of the boy of an English Boarding School who were already being fed a diet which ha been planned by good medical men and supposed to be adequate showed th boys receiving the extra milk, made better gains in height and weight an showed better mental development than those receiving the supposed adequa diet alone or with supplements other than milk. These results were lat confirmed in U. S. A. and also in our country and have led to the introductio of the Milk-in-School Scheme. In Great Britain and America hundreds thousands of school children under this scheme received extra milk at scho in addition to the diet and milk they got at home and the results have be officially reported as "effecting unquestionable improvements in the children physical well-being, zest and mental alertness and as constituting a gre social and educational advance." In India due to lack of an adequate supp of milk, a large scale application of this scheme has unfortunately not be possible.

Metabolism experiments on human subjects

The relative merits and the adequacy of typical rice and wheat diets India have been studied by Basu and his collaborators (10), (11) by means actual metabolism studies on human subjects. These metabolism studies cluded an estimation of the daily intakes and outputs of the nutrients li proteins, calcium, phosphorus, iron, copper and manganese and enable us decide as to whether adequate amounts of these nutrients were being suppl by the typical diets. The rice diets consisted of 550-600 gm. of rice, 100 g of pulse, 200 gm. of vegetables and 30 gm. of oil per day. The typical wh wheat diet was made up of 500-550 gm. wheat, 70-90 gm. pulses 200 g vegetables, 50 gm. sugar and 30 gm. of ghee per day. The daily prot intake with rice and atta diets varied between 76 and 82 gm. and on b these diets the human subjects were in positive protein balance and retai considerable amounts of proteins. It has been shown from these experime that the typical rice and wheat diets of India containing about 18 oz cereals per day were quite adequate with regard to the protein requirements human adults. With smaller amounts of cereals without at the same ti adequate protein supplements, the position would be quite different.

The Indian rice and wheat diets were also found to be adequate w regard to their phosphorus content.

The story, however, is quite different when we come to the calci content of typical Indian diets. Both the rice and atta diets were very lo calcium. The rice diet contained on an average 234 mg. and the atta about 300 mg of calcium, while the maintenance calcium requirement found to be 432 mg. per day. On both the rice and wheat diets the ac experimental subjects were almost always in negative calcium balance or other words, they excreted more than they took. The deficit was more w the rice than with the wheat diets. One of the greatest defects of typ Indian diets is insufficiency of calcium and also of course, of vitamins. deficiency of calcium and all other defects in the diets can be made up by incorporation of 10 oz. of milk in the diet per day. But milk is in s

VISHAKA RAINS DESTROY ALL PESTS.

pply in India and is also beyond the means of the average Indian. ıcorporation of about 100-200 gm. leaves of pumpkin (*Cucurbita pepo*) (11) · 200-300 gm. of cabbage, lady's finger or drum-stick or amaranth (12) in the ıily diet brings an adult from negative to positive calcium balance. The ılcium content of pumpkin leaves is very high, ranging between 240-300 mg. ɜr 100 g. of leaf. Lime taken with betel leaves (13) and bones of small fish ken whole (14) also supply considerable amounts of calcium and bring ıman beings in positive calcium balance.

One of the most serious defects of both the rice and wheat diets in India the deficiency of several vitamins which can be made up by the provision of lequate amounts of milk which is not feasible at present. Fresh green egetables contain carotene and their intake in sufficient amounts can supply the eeds of vitamin A and also to some extent of vitamin C which is abundant in itrus fruits like oranges, lemons and in *amla*[1] and guavas. Partial replacement f rice by atta, and intake of under-milled rice, preferably parboiled, will meet ıe requirements of B group of vitamins. The wheat diets are better in these ɜspects. With plenty of sunshine in this country, the need for vitamin D for dults is not great. Infants and growing children in whom bone development goiog on rapidly require supplies of vitamin D in the form of egg yolk, milk ıt or fish liver oils (like cod or halibut) or the synthetic vitamin.

oncluding remarks

The limitations and deficiencies of the typical South Indian rice diet have een fully described in the preceding pages. The problem has become more cute due to the present world shortage of rice and the Government have to ace a difficult problem in trying to supply adequate calories to the people of ndia. It is not the intention of this article to discuss the present problem but nly a survey of the nutritive value of rice diets has been made and means of mproving the nutritive value of these diets have been indicated.

There is nothing inherently bad in rice. It is the manner in which it is ısed to form the basis of a diet that is responsible for the poor quality of the ommon Indian rice diets. Firstly too much of rice is taken by the rice-eaters o the exclusion of adequate amounts of body-building and protective foods ich in proteins, fats, minerals, and vitamins. These latter ingredients are upplied by relatively costly foods like milk, fish, eggs, meat, fresh green egetables and fruits. While most of these supplements can supply one or nore of the missing factors, milk alone can make good all the deficiencies of he rice diet. Secondly the nutritive properties of the rice itself are very often lecreased by the treatment to which rice is subjected before it is eaten. The ıdverse effect of milling, of washing the rice before cooking and of throwing ıway the water after cooking it with too much water—all these procedures emove a considerable part of valuable nutrients. Avoidance of these prac-ices and legal enforcement of under-milling and parboiling of rice would ɔrevent the loss of nutritive value. Parboiling causes the vitamins to diffuse nto inner layers and thus prevents their loss during milling.

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ANIMAL NUTRITION WITH SPECIAL REFERENCE TO MILK PRODUCTION

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India possesses nearly one-third of the total cattle population of the world. Yet, the total production of milk in the country is enough only to give 4.5 ozs. of milk per head of human population per day (Milk Marketing Report, 1950, Page 43). This is because the milk production of the average Indian cattle is very low as compared to foreign breeds of animals. While factors responsible for the low milk yield of the Indian Cattle are many, malnutrition is the most important cause. It has been stated that 50-60% immediate increase in the milk yield of the indigenous breeds of cattle is possible by proper feeding and management (Kartha, K. P. R., Indian Farming 1, 220, 40). This has been proved also by the increased performance of the animals purchased by organised dairy farms.

The effects of under-nourishment are many in the case of dairy cattle. In the case of calves, under-nourishment leads to various deficiency diseases and ultimate death of the calves. In fact the one cause of the high mortality rate among calves is malnutrition. The economic loss involved in this high rate of calf mortality, is very prohibitive. Even when the calf survives, malnutrition retards its growth to such an extent that it takes 4 to 5 years for the heifer to take the bull and drop the first calf. Then again, in the case of Indian cattle the calving interval often extends upto 600 days. Frequent abortion among pregnant cows is also attributed to malnutrition. It is needless to add that the poor performance of the Indian cows at the pail is due to improper nourishment. The marked improvement in milk yield recorded in certain breeds of Indian animals under proper feeding and management bears testimony to this fact. While this improvement in the yield of milk may not be the same in all breeds of cattle, it is certain that all of them will respond appreciably to better feeding and management.

If Anuradha (Nov. 19—Dec. 1) is over, anxiety is over.

It is a well known fact that the feeds and fodders available in India are ifficient both in quantity and quality so far as the optimum nutrition of the isting livestock is concerned. An increase in the quantity of the bye-products the human food crops is not feasible without increasing the acreage or the tput per acre. Even if this is done by intensive cultivation, these bye-oducts are not suitable for increased milk production. An ideal feed for cattle r general maintenance and for milk production in particular, is built around a od quality green fodder. Green fodders in general and the legumes in rticular form the best natural feed for cattle-both for providing all the neces-ry nutrients including minerals and the bulk needed to give a feeling of tisfaction to cattle that generally have a capacious stomach These fodders t only increase the flow of milk but also reduce the cost of milk production a considerable extent. This is why there is more milk available in the untry in the post-monsoon period. So, the best way to increase the milk oduction in the country is to provide good quality green feed to our cattle roughout the year. This is not possible unless fodder crops are cultivated a larger scale than at present. At the present moment food production per re is low and it may not be practicable to set apart any cultivable land for dder crops as long as imports of food continue. Thus the possibility of our rmers being able to feed their cattle better depends upon their ability to crease the production of human food per acre, and release a certain amount the cultivable land for the grazing of their cattle and for growing fodder ops This kind of mixed farming will increase the productivity of not only e cattle, but also of the land by the utilisation of cattle manure. In ddition, when the cattle are better nourished their performance both at the ail and the plough increases enabling the cultivators to reduce the number of ttle to be fed. This in turn increases the availability of fodder to the emaining animals: The increased production of milk when the animals are ell nourished will increase the consumption of milk in the country leading to general improvement in the standard of health of the human population s well.

Having come to the conclusion that increased cultivation of fodder crops a symbiotic system of mixed farming is essential for the augmentation of ilk production in the country, one has to decide what type of fodder is to be ultivated. This mainly depends upon the fodders suitable for milk produc-on, and the possibility of cultivating them in the different areas of the ountry. It may be categorically stated that it is useles to rely on coarse dry odder for milk production. These coarse dry fodders like the straws of food rops contain too little protein in comparison with the total nutrients, to be uitable for milk production. For the purpose of milk production, the utritive ratio of the fodder should not be wider than 1 : 10, the narrower this atio, the better it is for higher milk production. Dry fodders like rice straw nd wheat straw have very wide nutritive ratios like 1 : 40, and are therefore ot suitable for milk production. Grasses like Guinea, Napier, etc. have utritive ratios ranging between 1 : 10 and 1 : 12. These are therefore easonably good for milk production. Almost the same remark applies to all orest grasses also; that is why there is increased flow of milk during the ainy and winter seasons when there is grazing available. But the fodders leal for milk production are the leguminous crops like Berseem (*Trifolium lexandrium*) and Lucerne (*Medicago sativa*). These have nutritive ratio auging from 1 : 3 to 1 : 4 and hence their suitability for maximum milk ro luction. Another special significance of these fodder crops is that they nhance the fertility of the soil, which is, as a rule very poor in India. Table , given below shows that the yield of these crops are at least as good as those f the less nutritious crops like green jowar and maize, if not better.

TABLE I

Distribution of yields of certain fodder crops

(Report on the development of cattle and dairy industries of India, By N. C. Wright, page 115.)

Yield Maunds/Acre	Percentage giving yields within limits shown in 1st column					
	Jowar	Maize	Oats	Berseem	Lucerne	Grasses
0— 199	37	61	35	22	26	17
200— 399	52	36	56	35	40	24
400— 599	7	3	9	19	23	36
600— 799	4	0	0	9	4	5
800— 999	0	0	0	9	7	6
Over—1000	0	0	0	6	0	12
Total ...	100	100	100	100	100	100

It is not yet certain, how far such fodders can be produced economically to allow profitable milk production. From Table 2, it is evident that lucerne can be grown at the same cost as green maize, and berseem as cheaply as green jowar.

TABLE 2

Distribution of costs of certain fodder crops

(Report on the development of the cattle and dairy industries of India By N. C. Wright. Page 165, 1952. Manager of Publications, Delhi.)

Cost/maund	Percentage giving yields within limits shown in 1st column					
	Jowar	Maize	Oats	Berseem	Lucerne	Grasses
Rs. P. As. P.						
Below 1 11	52	18	22	50	20	40
2 0 to 3 11	34	40	43	18	37	28
4 0 to 5 11	8	18	14	16	7	17
6 0 to 7 11	2	18	0	3	6	7
8 0 to 9 11	0	3	0	6	13	2
11 0 to 11 11	0	0	4	3	8	0
Over 12 0	0	3	17	3	13	3
Total ...	100	100	100	100	100	100

If these conclusions can be taken as applicable to India as a whole, th constitute strong arguments to expand the cultivation of these two fodd crops throughout the country. Senji (*Melitus parvi flora*) Shaftal (*Trifoliu resupinatum*) and Methi (*Trigonella foenumgraecum*) are other legume fodd crops which, though not so good as Berseem and Lucerne, can be grov under less favourable soil condition and irrigation facilities. All the

nourishing, succulent fodders though their yields are not so good as ıpared to the high yielding *berseem* or lucerne. Cowpeas of different ieties and *guar* or cluster beans constitute other legumes grown in summer nths along with maize, Although the yields of these are not very high, ıg legumes they have high nutritive value for milk production and they are) soil improving crops.

Among the non-leguminous fodder crops jowar is the most important, icularly in the low rainfall areas. It produces a large quantity of green der of medium nutritive value in a short time. On account of its adapt- ity to a variety of soil and climatic conditions and high sustaining value, o her crop is considered equivalent to it in forage value during the summer nths. It is sweet and juicy and is very nourishing and hence increases the v of milk. Oats is not extensively grown in India except on military farms. s a nutritious fodder liked by all classes of livestock, particularly by horses. ving a narrow nutritive ratio, it is also very good for milk production Oats lso grown for grain for feeding to milch cattle. Maize is an important *rif* fo lder sown in mixture with Cowpeas. This is also a fodder of medium ritive value liked by cattle. When cut along with cowpea and fed to cows s highly suitable for milk production.

While most of the above fodder crops, except lucerne, are annuals to be n every year, grasses like Guinea, Napier and Rhodes are perennial fodder ps which have established an important place in cattle feeding. Although dium in nutritive value, the high yield of these grasses under irrigated ditions have secured for them an important place in feeding of cows for k production. The average composition as well as the digestibility of se fodders are given in Table 3.

TABLE 3.

verage percentage composition of certain fodder crops (I. C. A. R. Bull. No. 25)

Name of the Constituents		Jowar	Maize	Oats	Berseem	Lucerne	Guinea Grass	Napier Grass	Forest Grasses
de Protein		7.75	6.74	14,63	17.35	19.90	7.69	5.35	3.94
er Extract		1.73	2.09	2.14	1.89	1.81	1.67	1.89	1.13
re		32 36	35.95	32.88	25.91	29.51	37.33	31.90	31.30
rogen-free extract		49 61	47.07	36.44	40.61	34.68	39.44	44.16	55.65
... ...		0.59	0.73	0.67	2 69	2.80	0 85	0.46	0.85
... ...		0.42	1.63	0.76	0,64	0.74	0.90	0.80	0.16
estible nutri- nts per 100 lbs f the material s offered for eding.	Digestible Crude protein ...	1.0	1,2	2,6	2.8	3.6	1.2	0.96	...
	Total Digestible Nutrients ...	16.2	16.9	16.7	12.9	11.7	12.8	13.8	...
estibility Crude Protein ...		44	61	72	81	80	58	62	...

The practical significance of the nutritive value as indicated in the above le, will be more appreciated when the data in tables 1 & 2 are also taken into sideration at the same time.

The economic significance of green fodders for feeding to milch cattle lies he fact that these fodders can replace a good portion of the concentrates on tein basis without any adverse effect on milk production. Experimental a on this point hasn't been available in the case of all fodders, but from the

work of Das Gupta (Indian J. Vet. Sci. *13*, 196 & 279, 1943), on bersee this is fairly clear. Also the fact that cows and buffaloes maintained und village conditions give more milk when grazing is available during the monso and winter seasons, goes to prove this contention.

The place of pasture grasses in animal nutrition is not so well recogni in India, in view of the natural limitations in grazing. Nevertheless it is tak for granted that cows will graze throughout the year, and that for sou months, the whole of their nutritional requirements will be supplied grazing alone. This is particularly the case with most of the cattle in Ind except those maintained on organised dairy farms. Experience has shown th best use cannot be made of pastures if cows are allowed uncontrolled access the whole grazing area throughout the growing season. Rotational grazi system, where pasture is divided into paddocks and grazed in a regualr orc of rotation allows pasture in the unoccupied paddocks to grow uncheck whereas continuous grazing converts the pasture into nothing but a place exercise for cattle. When pastures are luscious and plenty, the avera dairy cow will maintain reasonably high production without any supplementa feeding at all, but the high yielding cow may not be able to consume all t nutrients she needs for her high production by grazing alone. Therefore, maximum production it usually pays to feed a high producing cow so carbohydrate—rich concentrate. Luscious pastures are rich in protein a even high yielding cows can get all their requirement for protein fr grazing alone when pasture is good and abundant. Hence there is seld any need for any protein-rich concentrate when green pasture is available plenty and this is the economy in grazing. Cows enjoy variety and her even when good grazing facilities exist, a small allowance of hay or straw very much appreciated by them. Unfortunately grazing facilities do not l indefinitely and pastures dry up resulting in a drop in milk producti This is the indication for supplementing the feed by cultivated fodder cr and some concentrates. It is here, a judicious feeding will effect pro economy in milk production.

Cows vary in their inherited capacity for milk production; a h producer does not, as is sometimes believed, produce more milk from the sa amount of food than what a low producer would produce. The keen appe and greater capacity for food stimulates high yielding animals to eat more t low yielding animals. Therefore, if not fed liberally, their milk yield w decline to the level permitted by the limited nutrient intake. But on the ot hand, the yield of the low producers cannot be increased beyond their inheri capacity and excess nutrients are stored in the form of fat. For this rea it is a good policy to feed cows according to their production. If all anim are fed alike, as is very often done under village conditions, the good produc will be underfed and the poor ones overfed. Profitable milk production co neither from cows which are half-straved, nor from cows that are overfed, from those receiving a sufficient quantity of the right kind of food. Only constant obervation and calculation can one determine when and to w extent roughages and concentrates can be fed profitably in addition to graz

Dry roughages commonly fed in India are the straw from cereal crops their nutritive value is very insignificant particularly from the point of view milk production. All the same, when no other fodder is available, or w other fodders are not available in sufficient quantity, these dry coarse fod serve the useful purpose of filling the stomachs of the cattle and giving the feeding of satisfaction. And it is then that all the nutrients necessary for animals for their maintenance as well as for milk production have to

lied by way of a concentrate ration properly balanced in protein, carbo-ate, fat, minerals and vitamins. But when green fodder is available in ty, concentrates may not be necessary at all, at any rate so much care need pe taken in providing a balanced concentrate ration as all the minerals, nins and proteins are supplied by way of the green grass or green fodder. prepared hay and silage are also good substitutes for green fodder, but are very seldom prepared in the Indian villages. However, they rightly rve a place in animal nutrition for conserving the surplus fodder for e use.

In addition to feeding adequately, it is essential that a satisfactory water ly be provided for cows in general and those in milk in particular. e the quantity required varies with different factors like the season of the nature of the feed, amount of milk being produced by the cow, etc. safer to allow the cows free access to an unlimited supply of clean water ghout the year.

Unlike in foreign countries agriculture in India is very much dependent bullocks for the motive power. In spite of the introduction of tractors, position is bound to remain as it is, particularly in the Indian villages e the holdings are small. The performance of the bullocks depends ly on their own feeding, as calves and as adult animals. Calves can be ght up well only when the cows give plenty of milk, and a semi-starved stunted calf is not likely to grow into a good bullock. So, an increase in milk production of our cows alone, can improve the condition of our cks, which carry the main burden of the agriculture and rural transport . This is not possible unless the cow is pulled out of the depths of the us negligence of the present day and given her due place of honour in a biotic, mixed farming system when both the farmer and his family iding farm animals, and the fields will be in a state of proper nutrition capable of maximum production. Since these are all so much inter-ndent one cannot by itself go ahead without influencing and improving condition of the other. So when the condition of the cow and her uction are improved by proper feeding and management, naturally the omic and nutritional state of the farmer is bound to improve by the sale consumption of dairy produce. So also the use of farm yard manure is d to improve the productivity of the fields. Good milking cows brought in a properly nourished state are bound to bring forth strong, healthy es which will grow into good bullocks. These bullocks could do as much as, two or four of the present-day bullocks, which also will increase the uctivity of the soil and make more feed available to the existing animals. is clear that the future of Indian Agriculturist very much depends upon easing the milk production of the Indian cattle by proper nutrition.

BLAST DISEASE OR *BENKI ROGA* OF PADDY

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A disease of paddy under the name 'brusone' has been present in Italy more than a century. Although its cause was not exactly known in the nning, the disease has later come to be associated with the fungus *cularia oryzae*. This fungus is the greatest enemy of paddy cultivation. ccurs wherever paddy is grown, in India, Pakistan, Burma, Ceylon, Japan, mosa, China, Indo China, Philippines, Java, Africa, and North and South erica.

In hasta six grains; in chitta three grains; in swati nil grains (sowing of horsegram).

The disease appears first in the nursery as a brown spot on the leaves In the field it causes a destruction of the leaves and spreads to the leaf sheaths the nodes of culms, the rachis or inflorescence, stalks and the grains. Th leaves are destroyed as if by fire, and hence the disease is locally known a *benki roga* or disease caused by fire. When the stalks of the inflorescenc are affected, the tissues at the base of the earhead or 'neck' are destroyed an the heads sometimes bend down and are only partially filled. This conditio is known as 'rotten neck'. The spots on the grains are of an ashy colour an contain the fungus mycelium and spores in abundance. A high percentage o chaff is the result. Infection by insects like the stem borer also results i chaff, but whereas in blast affected earheads there will be some full grains, the borer infestation the whole earhead is usually converted into chaff, an stands out rather whitish in contrast to the golden-coloured normal earhead.

All samples of seed from an infected plot usually carry the infectio Besides this, the stubbles of an infected plot are also heavily infested and th disease never disappears altogether from an infected plot. So both types infection primary and secondary, are found in any plot of paddy. Treatment the seed can only partly control the primary infection. Seed disinfection obtained by treating the seeds if in large lots, in a seed treating drum with 0 per cent by weight of mercurial seed dressings like Ceresan or Agrosan G. I for about 10 minutes. If in small lots, the seed may be shaken with t requisite chemical in an air-tight tin or bottle for the same length of tim Secondary infection in the nursery can be controlled to some extent by a dustin with flowers of sulphur. It is difficult to control the infection in the field. T best that can be done is to cultivate only tolerant or resistant varieties of padd

There are hardly any varieties which are completely resistant to t disease. Some are tolerant to a greater or less extent. A few varieties ha been evolved at Coimbatore which are resistant to the disease to a great exte These are all long duration varieties and hence unsuited to the conditions Mysore, where irrigation is done from channels or tanks. According to a l prepared by the Senior Assistant Botanist, Paddy Section, of the Mys Department of Agriculture, the selections from Coimbatore sanna (S. 6 S. 684 and S. 699) and Halubbalu are susceptible to the disease. The disea occurs also on Banku paddy (a variety from Srirangapatna and another fr Tanjore) and more severely on S. 54 or Natanahalli sanna. The disease absent or rare in Mysore kaddi (S. 139), Bangarakaddi (S. 705), Mahara bhogam (S. 625), Alur sanna (S. 199), Ratnachoodi (S. 718, S. 749), Doddab (H. 294), Puttabatha (B. 1399), Bangaratheege (H. 497), the *malnad* variet like Musalli, Togarina, Walya, Honasu, Bilikannuhegge (B. 281), and in crosses between Bangarakaddi and Coimbatore sanna (S. 1088 and S. 10 and in two crosses between Gunasale S. 269 and Coimbatore sanna (S. 1 and S. 1079). These observations will have to be confirmed for the differ regions of cultivation. It is, however, interesting to note that coarse varie of the plains, and the *malnad* varieties are more tolerant to the disease t the fine varieties like Coimbatore sanna or Nagpur sanna. It has been fou that the plant characters associated with resistance of paddy plants to bl are a thicker hardened (silicated) outer wall of the leaves and infloresce stalks, a larger number of the silicated cells as also of breathing-pores stomata with silicated guard-cells, characters usually to be found in the co varieties. It is also known that an excessive application of nitrogen fertilizers increases the disease, and this is supposed to be a result of the e of excess nitrogen in reducing the thickness of the leaves, and reducing mechanical strengthening elements of the leaves and earheads. As obser

bove, hybridization of Coimbatore sanna paddy with coarse varieties like angarakaddi and Gunasale S. 269 has given rise to varieties which are lerant to the disease unlike the fine varieties.

Freedom from disease, however, is not absolute. A variety that is free om disease in any locality or season may fall a prey to it in another locality season. This is due to the fact that the fungus exists in more than one ysiologic race. The preponderance or absence of any one race of the fungus ill account for the relatively greater or less infection in any one year or cality.

The evolution of disease resistant varieties by hybridization has met with me success in Japan. It has been found that species of paddy with 24 romosomes like the cultivated *Oryza sativa* are susceptible to *Piricularia yzae*, while the wild varieties (species like *Oryza latifolia* and *Oryza minuta*) ith 48 chromosomes are highly resistant. The first generation progeny of ie cross between *Oryza sativa* and *Oryza minuta* was equally resistant.

Other methods of controlling the disease like spraying the fields with ngicides like Bordeaux mixture have made some progress in Japan where the overnment subsidises this work, which is further aided by an effective eather forecasting service for advising when and how to spray.

SEEDLING BLIGHT OF RAGI AND ITS CONTROL

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Ragi (*Eleusine coracana*) one of the major food crops cultivated over an rea of 17,11,500 acres in Mysore suffers from a seedling blight caused by the ngus *Helminthosporium nodulosum*.

The disease is widely prevalent all over the world on important food crops ke rice, wheat, oats, barley and other grasses. The fungus present on the eed or in the soil infects the germinating seeds and reduces the stand of the rop in the field. The infected crop produces only a poor yield of grain.

The infection on ragi appears on plants scattered throughout the field. t is severe in years of excessive rainfall. The fungus infects all parts of the lant from roots to earheads. It may appear at any time during the growth of ie plant. All the cultivated varieties including H-22 ; E.S. 11 ; K-1 and other ocal varieties of both '*Dodda*' ragi and '*Gidda*' ragi are affected. The ocal "*hullubele*" as also the irrigated varieties are highly susceptible.

Seeds which are heavily infected become enveloped with the mycelial rowth of the fungus, turn black, become soft and rot in the soil. 4-22 per ent of the seeds collected from an infected crop failed to germinate. The ngus invades the developing roots and the young shoots. Many young eedlings are killed before they emerge from the ground. Blank spaces occur ere and there along the drill rows. Such seedlings as withstand the attack nd come out of the soil become weak, sickly in appearance and grow slowly. n severe cases the disease appears prominently in patches here and there. he infection extends to the stalks and the young leaves of the seedling. An xamination of 20-25 days old seedlings at random showed about 40-50 per cent iseased seedlings with brownish to dark discolouration at the foot or basal ortions. The discoloured regions contained the spores and mycelium of the ngus.

In grown up plants irregular brownish blotches or streaks appear on the culms, leafsheaths, nodes, internodes, on the rachis, spikes and spikelets. The small brownish spots appearing on the leaves multiply and coalesce with one another. The discoloured blotches on the basal leafsheaths and culms enlarge, turn deeper in colour and become more and more marked as the plants grow up. The fungus sporulates freely in nature on the earheads. The infected earheads develop poorly. The grains are found partially filled and remain small in size. Spores and mycelium of the fungus are found in abundance on the infected grains. The spores are readily carried by the wind and disseminated over wide areas. Even the grains in disease free earheads get mixed with those of the infected earheads during harvesting and threshing. Infection is primarily carried on the palea and glumes of the grain. When such seeds are sown the fungus infects the germinating seed.

The fungus not only infects the living plants but also survives for many months on the remains of old infected roots, straw and stubble or on the other dead decaying organic material left in the field after the infected crop is harvested. When a field is cultivated repeatedly year after year to the same crop the infective fungus material accumulates in the soil and forms the foci of infection. The fungus becomes epiphytotic when conditions like excessive humidity and moisture are favourable for its rapid development.

Control.—Since the disease spreads primarily from the infected seeds it can be effectively controlled by disinfecting the seeds with fungicides like Agrosan G. N., Ceresan or Fermate at the rate of 2½ *tolas* for 15 *seers* of seed. The treatment does not in any way impair the germination of the seeds. On the other hand it increases the germination by 4 to 6 per cent and stimulates the growth of the seedlings. The seeds should be thoroughly covered with the fungicide. This is best done by putting the seeds and the required quantity of the chemical into a seed dresser and rotating it for 10 minutes. Smaller quantities of seeds may be put into a cylidrical tin with an air-tight lid and rolled from end to end on the ground or shaken well by hand. The treated seeds may be stored for a week or sown immediately. The chemicals are poisonous. Care should be taken not to inhale the dust. The hands and the containers should be washed well after the work is over. The treated seeds should not be consumed or fed to cattle. The cost of chemical for treating the seed required for an acre is about an anna only.

It is difficult to control effectively the secondary infection on the crop in the field. The infection can be reduced to a large extent by practising clean cultivation, adopting rotation and other good cropping methods.

NEW FUNGICIDES AND THEIR APPLICATION

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Fungicides are chemicals employed either in liquid or powder form to kill the fungi and their spores during their dormant or active condition on plants, seeds, soil, etc. They are mostly used to prevent rather than to control the infection by covering the parts of the plant with a fungicidal layer. Sulphur, copper and their products have been employed as fungicides for a long time. The sulphur sprays are very effective in controlling the external parasites while the copper sprays are mostly employed against the internal parasites. Sulphur was first used as a fungicide in 1821, in England against mildew of

eaches. It has since undergone many modifications being applied in sublimed r powder form as sprays or dusts on plants, seeds, and soil. It is largely sed in the form of fine dust and as sprays in a colloidal form or in combination rith lime. As a fine dust it is widely employed in the control of powdery nildews, as seed dressing against seed borne diseases (smut on jola) and as oil disinfectant mostly for the control of *anaberoga* (*Ganoderma lucidum*) of reca and coconut trees in Mysore. Among the new sulphur compounds) Colloidal sulphur at the rate of 2 lbs. in 100 gallons, (2) persul at 4 lbs. in 00 gallons and (3) Fernasul at 1 gallon in 60 gallons were tried as sprays for he control of powdery mildew on mango trees and compared with 1% Bordeaux mixture in a garden near Bangalore. The trees were just putting orth the inflorescence and were free from infection at the time of treatment. The spraying was repeated after about a month. Dusting with sulphur dust ras also tried in another garden. Of these treatments, spraying with Bordeaux nixture, Fernasul and dusting sulphur gave comparatively good results.

The most effective copper fungicide employed for over 70 years for the ontrol of fungus diseases is Bordeaux mixture named after the town Bordeaux n France where it was first discovered in 1882 by Millardet for the control of owny mildew of grapevines. This mixture consists of coppersulphate and me solutions prepared in definite proportions according to the strength equired for application. Later in 1887, Masson used the mixture with soda sh in place of lime and named it Burgundy mixture after the province of Burgundy in France. Other copper sprays in combination with ammonium arbonate, etc. developed later, but Bordeax mixture has come to stay being ailed as a universal fungicide all over the world. A properly prepared Bordeaux mixture is not only very effective as a fungicide but is also beneficial s a stimulant on green plants. It is relatively cheap and safe to handle. But t has its own limitations One has to take considerable trouble and care in ts preparation and application to derive the maximum benefit from the nixtures. Attempts to replace Bordeaux mixture with an equally efficient if ot a better fungicide have been of no avail. Bordeaux mixture that is generally used against areca *kolerogai* in Mysore is of 2% strength and $\frac{1}{2}$—1% against iseases of coffee, tobacco, potato and other crops in Mysore.

Copper sulphate solution (1%), mercuric chloride (0 1%) or formaldehyde 1 : 320) are employed as steeps for disinfecting seeds, tubers and other parts f plants. Steeping the seeds for 15 minutes in 1% solution of copper ulphate has been found to be very effective for the control of smut n jola in Mysore Formaldehyde, copper and mercury compounds are argely employed as dusts or steeps against seed borne diseases They form mportant constituents in several proprietory fungicides. These retard lightly the germination of the seeds.

Organic mercury compounds which came into use since 1913 are uperior to Copper carbonate and formaldehyde preparations. They increase he vigour of the seeds and impart a better stand of the seedlings in the field. A number of seed disinfectants of this type are now on the market. Among hese Ceresan new (German) and Agrosan G. N. (English) are widely employed s seed disinfectants.

The scarcity of copper, sulphur and mercury created by the 1st World War became more acute after the prolonged 2nd World War necessitating he rapid development and greater use of organic fungicides comprising the ithiocarbonates. Among the many products of this type that are now on the narket mention may be made of Arasan, Nomersan, Fermate, Dithane D. 14,

Dithane Z 78 and Copper 8 Quinolinolate. These fungicides contain in addition to the active chemical, an inert dust in the form of very fine carrier traces of an oil to prevent undue dispersion of the dust and a colouring materia to identify the treated seeds. They are very effective preparations and can b employed with ease and safety. Experiments conducted on a field scale wit Ceresan (dry and wet) Agrosan G. N. Arasan, Nomersan, Mergamma, T. M. T D. and Fermate at the rate of 0.2% by weight against seed borne diseases o ragi, paddy (*Helminthosporium* and *Piricularia*), jola (*Sphacelotheca sorghi* and coriander (*Fusarium sp.*) have given very promising results. The seed are dressed well with the required quantity of the fungicides by turning ther over continuously for 10 to 15 minutes in a seed dresser or by shaking ther thoroughly in a tin with an airtight lid. The treated seeds may be stored fo 1 or 2 weeks or sown immediafely.

The organic fungicides have no injurious effect on the germination of th seeds. The treatments stimulate the germination and increase the vigour c the seedlings. Storage of treated seeds does not in any way impair th germination. The percentage of germination varies with the different fung cides and varieties of seed. Plants raised from seeds treated with Fermat Agrosan G. N. and Nomersan looked better in growth and stand and presente a deeper colour than the crop raised from the seeds treated with the othe fungicides. The treatment reduced the incidence of infection and increase the yield.

These fungicidal dusts are poisonous. Certain precautionary measure have to be taken in dealing with these. The dusts should not be inhaled t much. The containers used for storage of treated seeds, the limbs and face o the user should be thoroughly washed after the work. The treated seed should neither be consumed as food nor used as fodder for cattle.

Of the many other spraying materials that are now on the market unde several proprietory names, Cupravit O b 21, Vitigran, Conc, Wetcol 1 Perenox, Dithane D. 14, Dithane Z. 78 and Copper 8 Quinolinolate wer tried on a field scale. The copper fungicides are highly concentrated fi dusts containing 15—50% copper. They are used in great dilutions of 0 to 0.5% solution. They readily mix with water, give a fairly goo suspension and adhere well over the sprayed portions. The required quanti of the fungicide is first mixed with a little quantity of water in a vessel b stirring with a stick and when all the powder has formed a paste th remaining water is poured, stirred well and sprayed.

These fungicides were used for the control of early blight of pota caused by *Alternaria solani* near Bangalore. The effect of the treatments c the yield and the disease was compared with that of 1% oil Bordeau mixtu and calcium arsenate solution (1 : 50) as well as the untreated crop. Tw applications were given, the first when the crop was about a month old a other a month later. The disease appeared severely on the unsprayed cro The sprayed crops were comparatively free from disease. The treat crops gave a higher yield from 5 to 35% over the untreated crop.

The advantages of these new fungicides over Bordeaux or Burgun mixtures are that they are ready made powders requiring no addition of li or soda ash and extra spreader or sticker. They are easy to handle a transport and save time in preparation.

MAJOR DISEASES OF CHIEF CASH CROPS IN MYSORE, THEIR SYMPTOMS, PREVENTION AND CONTROL

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SUGARCANE

Red rot.—This is the most serious disease of sugarcane caused by the ngus *Colletotrichum falcatum*. It is prevalent all over the world wherever garcane is cultivated. The mature leaves in the middle of the shoot begin ade, wither at the tip, extending down the margins leaving the centre green, ter the whole cane withers. Infection is observed in patches in the field. e affected canes become light and poor in juice. On splitting open a eased cane a sour smell is noticed and a reddish discolouration in elongated ches or streaks is observed at the internodes starting at the base. The ldening is marked near the nodes. Later, these red blotches extend horizon-ly having white central areas which are very characteristic of the disease. vities containing the mycelium of the fungus may appear in the pith. In ere cases of infection the cane becomes dry and pithy, assumes a dark wnish colour in contrast to the reddish colour of the early stage. The dish discoloured areas sometimes appear on the mid ribs of the older leaves lo. The spores of the fungus appear outside as small black dots at the des and on the dried leaves which form the foci of infection.

The disease spreads rapidly during heavy rainfall, in lowlying lands, in drained fields and on canes weakened by attack of insects or by other causes. ie spores on the diseased canes are conveyed by wind, irrigation water, ects and other agencies and invade through the cut ends of setts or through uries caused on the canes. Setts from infected canes produce disease. lect sound setts for planting from perfectly healthy crop. Discard all setts at show the slightest symptoms of reddening. Do not allow the setts to nd for several days before planting. Protect the ends of the setts soon er they are cut by dressing them with 1% Bordeaux mixture. Collect and stroy all dried and diseased canes and leaves. Avoid ratooning in areas ere the disease is prevalent and prevent excessive flooding and open good ins. Raise resistant varieties.

Collar rot.—This disease though caused by a different fungus *Hendernina sacchari* produces the same symptoms as red rot. Infection takes ace through wounds and roots. The top leaves wither from tip along the ges. On spitting the cane the upper part is usually pithy and dry in the ntre. Sometimes a central cavity, surrounded by dry white flaky pith is rmed along each internode. In severe cases these are found at the lower er-nodes also surrounded by red or brown pith. The roots at the lower des turn generally black and rot. The methods of control are the same as red rot.

Smut.—This is the most easily recognised disease of sugarcane. It is evalent more on thin canes than on thick canes and is caused by the fungus *stilago scitaminea*. A long, curved, whip like slender shoot, often several et in length is produced from the growing point of the cane. This abnormal owth is first covered by a silvery white, thin membrane, which soon ptures exposing the minute spores of the fungus as a dense mass of black st. Setts planted from infected canes produce the disease. Spores from eased canes infect at the nodes. Collect all the smutted shoots and burn

them so as to prevent the spores contained within them from being blown about. Use setts for planting from disease free crop. Immerse setts in 1% formalin solution for 5 minutes and cover them for 2 hours with moist gunnies before planting.

Brown leaf spot.—This is one of the commonest leaf spot disease of thin canes caused by the fungus *Cercospora longipes*. Spots appear as narrow oval, reddish spots on both surfaces of the leaf and not on the leaf sheaths. They enlarge forming a brown centre surrounded by red and yellow zones which are formed concentrically. Later the brown region increases, the centre dries up and loses its colour. Collect and destroy all the severely infected leaves. Use disease resistant varieties.

Ring spot.—This is also a leaf spot disease caused by the fungus *Leptosphaeria sacchari*. The disease usually appears on thick canes, 2-3 months old and reduces the vigour of the plant. Irregular elongated spots are abundantly formed towards the outer end of the older leaves. The spots commence as a purplish fleck on the surface, enlarge and dry up in the middle. Later they turn into small brown or yellowish patches enclosed by purple or brownish bands with yellow margins. Infection becomes severe in moist weather. The infected leaves dry up prematurely. Canes exposed to unfavourable environmental conditions suffer from the attack of the fungus. The disease does not kill the plant but hinders the vigorous growth of the cane. Collect and destroy all the severely infected canes so as to prevent further spread of infection.

Mosaic Disease.—This is a disease caused by the infective virus similar to that of mosaic disease of tobacco, tomato, potato, beans and other plants. Infection is easily reorganised by the peculiar mottling of the leaves. The longitudinal streaks of the green colour caused by the paling of many small and ill-defined areas are easily observed on the upper young leaves when held against light. Distinctive markings appear on the surface of the cane as streaks or stripes on the internodes, which may be pure yellow or green or red or yellow. Irregular whitish stripes may appear on older joints. The joints become shortened. The canes become pithy and poor in juice, crack at the internodes, shrink and dry up resulting in reduced yields. The loss may go up to 3+% according to the susceptibility of the varieties. Ratooning of infected canes should be avoided. Infection is not conveyed through the soil nor by contact. Do not use setts for planting from infected crop. Cultivate resistant varieties of canes.

COTTON

Wilt Disease.—This is a destructive disease caused by the fungus *Fusarium vasinfectum* which dwells in the soil. The disease is usually noticed in black cotton soils. Infection is observed on plants 7 to 20 days old, in patches which go on extending in the field. Symptoms become apparent when plants are 5-6 weeks old. The lower leaves turn yellow, wilt and wither. The upper leaves follow leaving the stalks bare. The fungus plugs the water conducting vessels of the roots and stems and cuts off the supply of water to the plant. A brown or black discolouration can be clearly seen in the water conducting vessels. The disease cannot be effectively controlled since the infection takes place from the soil through the roots. Pull out all the severely infected plants and destroy them so as to prevent further spread of infection. Practise rotation in severely infected fields. Raise resistant varieties. American cottons are immune to infection.

Angular leaf spot, black arm disease and boll rot.—This is a serious isease caused by bacteria *Xanthomonas malvacearum*. It was first describ-d in Lousiana in 1891. Leaves, petioles, stems, twigs and bolls are affected. 'lants, with poor growth in drought areas or poor soil suffer most. Small, regular, water soaked spots appear thickly scattered on the lower surface of ie leaves, bracts and bolls. They are usually angular, 3-5 mm. in diameter nd may coalesce along the main veins. An yellowish, varnish like, thin crust f bacteria appear on the upper surface of the spots on the leaves. The tissue t the spots dries up and turns brown. Rain water splashing from the nfected leaves and blown about by wind spreads the infection rapidly and auses a great loss of leaf.

When the infection extends to the stems and twigs it is known as black rm disease. Dead, black patches of varying sizes appear with an ooze in the ortical regions and girdle the organs, leading to the drying of the fruiting ranches. The plants become weak and break during high winds.

On the bolls the small, round, water soaked spots extend at their margins, ie central tissue dries up, turns brown or black. When the infection extends eep into the fruits the lint will be stained bright yellow. In severe cases ney turn black and rot. Young bolls and flower buds infected at the base hed heavily.

Use seeds from disease free crop. Disinfect seeds with either Cerasan or grosan G. N. at 3 ozs. for 60 lbs. of seed, by shaking them together oroughly for 15-20 minutes. Raise resistant varieties.

Root rot.—This is chiefly a seedling disease caused by the fungus *hizoctonia* which is capable of living in the soil for a considerable time. Mature plants are sometimes attacked. Soft yellow patches are noticed on the ender stems of the seedlings at the ground level. The patches later turn lack and the seedlings collapse. Old plants dry up and wither. The infec-on persists in the soil for 2 to 3 years. So the best way to control the isease is by practising rotation with non-susceptible crops.

Red leaf blight.—This is a physiological disease occurring on weak plants n poor and deficient soils. The leaves turn red, reddish brown or yellow and vither prematurely. Bolls shed heavily. The yield and the quality of lint re reduced to a great extent. Any measure taken to increase the vigorous rowth of the plant, such as, application of farm yard manure, compost or itrogenous fertilizers and good cultivation are beneficial in controlling the isease. When the affected plants show infestation by aphids or jassids, dust he plants with fine sulphur.

Powdery mildew.—It is, very easily recognised disease of cotton. The nder surface of the leaves become covered by the white shining mycelium of he superficial parasite *Cidium Sp.* The older leaves shed. The infection an be effectively eradicated by dusting the plants with fine sulphur.

GROUNDNUT

Leaf spot.—This is a major disease of the crop prevalent all over the orld. The infection caused by the fungus *Cercospora personata* is noticed sually on 1 to 2 months old crop. The lower older leaves are first attacked. he spots are brown to black, nearly circular, usually 2-4 mm. in diameter nd surrounded by a yellow ring. They may be found on the petioles and tems. The leaves lose their colour and are shed in great numbers. In evere cases the plants stand out with bare stalks. Infected plants do not

develop mature nuts. 30 to 50 per cent of the crop is lost due to infection Use seeds from disease free crop. The disease spreads through spore adhering to the seeds. Steep the seeds in 0.25% formalin solution (1 : 40 for 4 hours or for 1/2 hour in 1-2% Copper sulphate solution. Infectio may also be carried through the soil. It spreads in the field through win which blows the spores from leaf to leaf. The spores on shedded leave infect the soil. Spray the crop thoroughly with 1%. Bordeaux mixture Rotation of crops is beneficial in checking the spread. Raise exotic varieti which will have better power of endurance.

Root rot.—The infected plants wither due to the attack of the fungu *Sclerotium rolfsii* which is a soil dwelling one. The collar regions a infected near the ground level. The fungus passes on to the roots and int the seeds underground. Small brownish sclerotia, looking like ragi grain develop at the infected regions and drop down in great numbers in the fiel These sclerotia are hard, durable bodies which are capable of withstandin the vicissitudes of nature and reproduce the fungus under favourab conditions. Hence rotation and good cultivation are important methods keep the disease under control.

TOBACCO

Bacterial Wilt.—This is a serious disease of tobacco caused *Bacterium solanacearum.* The same bacteria attack other solanaceo crops like potato, brinjal, chilli, etc. and causes the same symptoms. T disease is noticed in patches in the field causing a damage of 5 to 25 Leaves droop, become pale green and gradually turn yellow. The bacte plug the vessels and obstruct water supply. The organism enters the ste or roots through wounds caused by some mechanical agency. When t infected plant dies the woody tissue and cortex get decayed and the bacte contained in the plant tissues are liberated into the soil where they a capable of surviving for a long time. Plants cultivated in such fie become diseased. The organism is carried and conveyed through infect soil, irrigation water, insects, birds, animals, tools and implements us and by the labourers working in the affected fields.

Use wilt resistant varieties. Adopt rotation with crops like cotton, whe etc. which are not affected by the tobacco bacteria. Irrigation or draina water from infected plots should be prevented from reaching the healthy plo Discard all seedlings from infected nursery so as to avoid the danger introducing the disease into a new field. Prevent the use of implemen tools, conveyance of infected soil, movements of animals and labour fr infected fields to healthy fields.

Frog eye leaf spot.—This is a leaf spot disease caused by the fung *Cercospora nicotianae* occurring in all tobacco growing areas. The dise appears on the seedlings, on plants in the field and in the curing bar Circular, sometimes angular spots appear with an ashy white or pale bro centre, surrounded by a narrow dark brown margin. Spots unite with a another resulting in irregular patches. The leaves crack from too many sp and dry up. Spores of the fungus are found at the white centre. These easily carried by wind and other agencies and spread the infection. The fun is seed borne which may be controlled by disinfecting the seeds with form dehyde or silver nitrate solution 1 : 1000 prior to sowing. Diseased seedli in the nursery may be sprayed with 1% Bordeaux mixture. The spread of disease in the field may be checked by priming the lower leaves early. incipient infection on the crop may develop seriously on the harvested lea

the barn during curing. This damage which will be very destructive may prevented by rapid drying.

Damping off.—The seedlings collapse suddenly due to the attack of fungi *thium* or *Phytophthora* in the nursery beds. The fungi which dwell in the il infect the stem and girdle it at the surface of the soil. The disease is ticed in patches killing the seedlings. It spreads rapidly in beds that are -ventilated or ill-drained and during heavy rainfall. Plants turn pale green d wilt. The stem and leaves are ultimately decomposed. Avoid beds nich are previously infected by the pathogens. Sow thin. Spray the beds th 1% Bordeaux mixture, before sowing the seeds and again a week after eir germination.

Powdery mildew.—This is a common disease caused by the fungus *rysiphe cichoracearum.* The fungus grows superficially on the surface of e leaf giving it a powdery appearance. The infection first starts as a greyish nite, felt like patches, which rapidly enlarge covering the entire surface of e leaf. The infected leaves may become thin and papery, wither, turn own and dry up. Lower leaves are first attacked and the other leaves llow. Infection is noticed usually on fairly grown up plants. Disease reads rapidly in humid weather where the crop is very dense. It may be ntrolled by attending to proper aeration of the plants, by wide spacing and clean cultivation. All the infected, especially lower leaves may be collected a bag or basket and destroyed immediately so as to minimise the spread of fection. Infection in the nursery and on young crops in the field is effectively ntrolled by spraying with 1% Bordeaux mixture.

Stem rot or Sclerotium blight.—A soil inhabiting fungus *Sclerotium lfsii* infects the stem of the plants and girdles it near the surface of the soil. rownish lesions are formed and gradually extend both upwards and down-ards. The fungus invades the vascular bundles. The infected plants remain unted, wilt, collapse and become brown and dry. In advanced stage, a pious, white mycelial web grows over the lesions and fan like strands tend over the margins. Numerous spherical, white to brown coloured bodies out the size of ragi grain develop on the web. These are the selerotia which op to the soil in great numbers and rest in the soil for some years and opagate the fungus during favourable periods. Remove and destroy all the fected plants as soon as they are noticed.

Mosaic.—This is the first virus disease that was found to be highly fectious. It is prevalent all over the world. It occurs on plants of all ages. ne symptoms vary according to the type of virus which are many in number. ne disease is transmitted by aphids and by labourers working in the field. eaves become mottled with alternate patches of light green or yellow or dark reen, reduced in size, curled or wrinkled or crumpled or distorted with irregular vellings or may be excessively branched. The infection persists even in ied leaves in the field. Seed beds should be thoroughly sterilised by burning. ompost from infected tobacco fields should not be used. All the infected ants should be scrupulously rogued. Clean cultivation and rotation should practised in infected locality. Resistant varieties should be raised.

Broom rape or Orabanche.—This is a flowering parasite which is unable manufacture its own food but grows attaching itself to the roots of the bacco and draws the nourishment for its maintenance. These are found in atches in the field growing 6"—18" tall as whitish or yellowish plants at the ase of tobacco plants. Their leaves are scale like and the stems are full of owers. These flower heads should be removed before they set seed. The

seeds germinate only when they come in close contact with the roots o tobacco from which they could secure their nourishment. Practise rotatio in severely infected fields with crops that are not susceptible to the attack o the parasite.

POTATO

Ring disease.—It is a bacterial disease caused by *Bacterium solanaceo rum.*—This is a very common disease of potato being familiarly known a '*Bangadi*' or '*Pore roga*'. The plants suddenly wilt. The leaves hang down a if the stalk had been cut through. A brown ring is noticed along the vascula ring within the cut tuber. On squeezing such a tuber pearly drops of slimy liqui ooze which contain millions of bacteria. The bacteria invade the tuber, stall roots and stems and prevents the conduction of water by plugging the vessel Hence the wilting. Primary infection takes place by planting infected tube from where it spreads into the growing shoot and roots. Secondary infecti spreads through irrigation water, implements and tools used in the plo When once the soil is contaminated by having a diseased crop previously t infection occurs through wounds at the base of the stem or roots. Use healt tubers for planting obtained from disease free crop. Discard all the tube that show the slightest signs of brown ring. Avoid irrigation from infect plots to healthy plots. All cultural operations should be finished in the healt plots before taking them up in the infected plot. Dig out entirely all t tubers of the diseased plants so as to minimise the spread of infection in t plot. Discontinue potato cultivation for some years in fields contaminated a diseased crop. Neither plant tobacco, tomato, chilli, brinjal and oth solanaceous crops for 2 to 3 years. Disinfect the knives used for cutting se tubers with mercuric chloride solution (1 : 1000) whenever infected tubers a cut and thus avoid contaminating next healthy tubers while planting.

Early blight.—It is caused by the fungus *Alternaria solani.* T disease is usually noticed on the crop when the tubers begin to form. Sma isolated, brown spots appear scattered over the leaves mostly at the tips a margins. The spots may be irregularly circular with narrow concentric rin The older spots turn dark brown, dry and brittle. The spots in severe ca unite, the leaves fade and curl up. Loss of efficient leaf tissue reduces vigorous growth and affects the yield. Tubers from affected plants do develop well. The loss may vary from 30-50%. Infection rapidly spre through spores of the fungus carried by wind. Spray twice with 1% Borde mixture or with calcium arsenate solution 1 lb. in 50 gallons with lime ca inate when the crop is 20-30 days old and again a month later. Remove infected plants and burn them after harvest to minimize infection by spo Tobacco, tomato, brinjal are also affected by the same disease.

Stem, Root and tuber rot:—The disease is caused by the fun *Corticium vagum* which infects the growing crop at or below the gro level. The lower branches wilt first. Leaves dry, turn brown, and stem rots. The infected collar region becomes covered with a film or work of white hyphae and ragi-grain-like sclerotia. The plants rem stunted in growth and the tops may develop a rosette appearance. Tub remain small. The fungus invades the tubers and forms thick strand white mycelium and black or brown crust like sclerotia. Use clean seed obtained from disease free crop. Plant tubers after steeping in 1 : 1 mercuric chloride solution for 1½ to 2 hours in an earthen or wooden ve The disinfected tubers may be dried before planting. Do not use the stee tubers as food or fodder.

Dry rot—The disease is caused by *Fusarium oxysporium*. Infection es place from diseased tubers. The plants wilt when about a foot high. aves fade, curl or their margins roll. Roots partly die, become brittle l bear pink or white growth of hyphae which invade the vascular ndles. The tubers rot dry, shrivel and become light. The inside of the er turns brown. The fungus and its spores hibernate in the infected ers and in the soil. Select disease free tubers for planting from non-ected crop. Collect and destroy all infected plants. Practise rotation h non-susceptible crops.

Virus disease.—There are several kinds of viruses affecting the potato nt. Symptoms vary according to the type of virus. The plants may nain stunted, leaves may show crinkling or rolling, may be discoloured in eaks or reduced in size. Disease spreads by planting tubers from infected p or through insects in the field. Tubers do not develop. Disease free ers preferably from the hills, should be used for planting.

CHILLI

Fruit spot or Ripe rot.—Anthracnose —This a serious disease caused by *llletotrichum capsici*. Infection usually starts when the plants are in wers. It extends back through the flower stalks to the stem, turns the k brown and then into long, narrow white strips. The flowers droop and up and the branches wither and die. Infected fruits show marked nptoms. Roundish dark or pale depressions or spots appearing on the its develop later black dotted fruit bodies of the fungus arranged in con-ntric bands. The flesh of the fruit dries up and shrivels. Such infected its are readily made out when the fruits are spread out in the drying yard. fection spreads rapidly during rainy weather. Use disease free seeds. llect and destroy all the infected fruits and prune off the diseased branches. ray the crop with 1% Bordeaux mixture.

Leaf curl.—The leaves curl up and remain small putting forth a tufted pearance. Severely infected plants do not flower and the fruits from diseased nts sometimes show curling. This is supposed to be a virus disease nveyed by thrips. Eradication of the insect vector by spraying early with cotine sulphate or dusting the crop with sulphur controls the disease.

CORIANDER

Wilt disease.—The disease is usually noticed in black cotton soils. fection occurs in patches in the field on plants 1-2 months old. The fungus *usarium* sp. infects the roots, invades the vascular bundles, prevents the ssage of water into the plant. The plant wilts and dries up. The fungus ells in the infected soil and on infected roots and plants in the field. actise rotation Use seeds from disease free crop. Disinfect the seeds with rmate or Agrosan G. N. at the rate of 2 ozs. for 30 seers of seed before wing.

Powdery mildew.—It is a common disease of Coriander appearing on ves and flowers wherever the crop is cultivated caused by the fungus *ysiphe polygoni*. The infection is noticed as white, floury patches on the ves and flowers and spreads rapidly in the fields. It is a superficial parasite ich can be easily controlled by dusting the crop with fine sulphur.

F YOU ARE FREE WITH THE SEEDS DURING SOWING, DON'T EXPECT TO REAP ANYTHING.

SPRAYING AND DUSTING EQUIPMENT AND TECHNIQUE

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The object of spraying and dusting is to give a uniform coating of a toxi substance (fungicide or insecticide) on the surface of plants by means c suitable appliances, so that the disease producing fungus or insect coming i contact with the material will get killed.

The idea of applying fungicides originated from the use of certai substances in an empirical manner, but the definite use of a fungicide starte with the accidental discovery of Bordeaux mixture by Millardet in 1882, whi working with downy mildew of grape vines. Fungicides are chiefly th compounds of Copper, Mercury, Iron and Zinc ; besides, a number of syntheti compounds are also used as fungicides.

Fungicides are of two kinds, direct or eradicant and indirect or protectan The direct fungicides will kill the fungal mycelicum or spores on the surfac of the plant as in the case of lime-sulphur used against powde mildew. The protectant fungicide prevents the fungal infection as in the ca of Bordeaux mixture. The former is applied to the infected plants, where latter is applied before the fungal infection. The success of fungicid depends largely upon how well they come into contact with the fungus in th case of direct fungicides and the degree of uniform distribution in the case preventive fungicides.

Spraying mixtures which are commonly used are—(1) Bordeaux mixtur (2) Burgandy mixture, (3) Lime-sulphur, (4) Calcium arsenate, (5) Zi sulphate.

The efficacy of spray mixtures is enhanced by the addition of adhesiv or spreaders like Resin-soda, Lime-caseinate or cheap vegetable oils li groundnut oil, coconut oil or gingelly oil.

The effectiveness of a spray is judged by (1) its toxic action on t fungus, (2) its not-toxicity to the host plant, (3) its ability to cover the enti surface, (4) its rententivity on the sprayed surface ; besides, its bei economical, simple and quick in preparation and safe in handling.

The application of the fungicide in the form of a fine dust is sometim preferred to spraying as in the case of powdery mildews, rusts, etc. T commonest fungicide used in the form of dust is sulphur. It was fi employed by Robertson in 1821 against the powdery mildew of peaches. number of dust fungicides are now in use against seed borne and soil bor diseases. The active material is diluted with a suitable 'carrier' ashes chalk powder which are inert substances.

Dusting is preferred to spraying because of the shortage of water, t difficulty involved in the preparation of a spray mixture, and the saving time and labour involved. It is impracticable in the case of coffee and are plantations.

While dusting, care should be taken to see that the dusting is done ea in the morning when the leaves are wet with dew in order to secure go adherence of the dust to the surface.

EXAMINE THE SEED BEFORE SOWING ; EXAMINE THE HORSE BEFORE MOUNTING.

Equipment.—In order to derive the maximum benefit from the application a fungicide, it is essential that the equipment used for spraying or dusting ould be efficient. A number of sprayers and dusters of different sizes have en designed to suit different sets of conditions. A sprayer used for spraying ops on a fairly large scale will have a tank for holding the spray, usually ovided with an agitator to stir the mixture sprayed. The tank is connected a pump worked by hand or by engine. The spray is forced by the pump o a compression chamber of different design. In certain simple sprayers, one gallon pneumatic sprayers, the tank is not filled more than three quarters its volume and the remaining space above the liquid serves as the com-ession chamber. The spray is led from the compression chamber to a hose, other end of which is connected to the spray gun provided with a nozzle. e nozzle may vary in size and shape according to the nature of the discharge uired. The hose also may vary in number and length according to the d. The spray gun is provided with a stop-cock at the point of its attach-nt with the hose.

One gallon pneumatic sprayers are useful in areca gardens, where the ayer is carried to the top of the trunk. D. S. P. sprayers are used nerally on the Coffee plantations. These sprayers are worked by hand and take two lines of hose. Bucket pumps are used in cases where bushes trees are to be treated on a small scale. These sprayers are worked by nd and the buckets serve the purpose of the tank. Wheel barrow sprayers provided with big tanks and powerful pumps worked by power are pted for large scale treatments.

Similarly, dusters vary in size from the simplest hand dusters to huge and vy dusters worked by power. These are made to dust fungicides or ecticides in the form of fine dust to cover the surface of foliage uniformly. e stream of air produced by the bellows, fans, or pumps picks up the dust ide the reservoir of the duster and applies it to the surface of the plant in form of a uniform cover. Rotary, plunger and bellows types of hand sters are convenient for use in orchards, and small vegetable gardens, ereas heavy and power driven dusters or air planes are used for dusting ge areas.

While using sprayers or dusters care should always be taken to see that appliances are well cleaned, lubricated and parts worn out replaced. ter the operation the parts should be disconnected, cleaned and greased.

Technique.—The success of spraying or dusting depends upon the lful way in which the surfaces of plants are covered by sprays or dusts. e application must be thorough and in time. The correct technique of plication is learnt by practice and observation of the results.

The nozzle plays an important part in spraying or dusting operations. nce the selection of the right type of nozzle or its proper adjustment is very portant. Thus by the proper manipulation of pump and nozzle, the volume the spray and its fineness can be adjusted. Spray volume is increased by reasing the pressure, size of the orifice in the nozzle and the number of zzles. Spray fineness is increased by increasing the pressure and reducing size of the orifice of the nozzle; and the carrying distance of spray is reased by increasing pressure, reducing the angle of spray and enlarging the fice of the nozzle.

In a spraying operation an even coverage is required with the minimum stage of material: slight dripping immediately after the operation indicates

good coverage, whereas heavy dripping suggests an excessive wastage o material and non-dripping an insufficient coverage. The speed of the movemen of the spray-gun governs the amount of spray applied.

While spraying trees, one should see that the under surface of the leave which usually harbour diseases and pests are well covered by the chemical. So the trees or large bushes are sprayed first from underneath and then from outside and around by steadily moving the spray gun in an upward and down ward direction. The direction of the breeze must also be noted. It is no advisable to dust or spray when there is strong wind as, then there is a grea chance of wastage of material. If it is unavoidable plants should be sprayed commencing from the windward side half-way.

SUBSIDIARY FOODS FOR MYSORE

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Subsidiary foods have always figured in the Indian dietary. Some c them are found in menus served on certain days of the week and holidays; i such cases, they are intended mainly to introduce an element of variety in th diet. Others are used on days of fasting, when no staple foods are allowed And there are still others which people turn to in times of food scarcity. Thes different types of subsidiary foods comprise foodstuffs which do not normall form the staple food. Usually, they supplement the staple food though ther are instances which go to show that, in several countries, they have partiall or wholly substituted staple foods under the stress of special circumstances.

The progress and popularization of the knowledge of nutrition an dietetics during the past 30-40 years in India and abroad have given the publ an idea of the nutritive value of a large number of familiar and less familia articles of food. For example, it is now possible to know, fairly accuratel the nutritive value of the average Indian diet, the "Proximate principles" lik the protein, fats, carbohydrates, vitamins and minerals it abounds or lacks i and the way to correct the diet and make it "well-balanced" even in tim when food is not in abundance. In this respect the subsidiary foods have play a very important role, undreamt of before.

As early as in 1937, the Nutrition Research Laboratories, Coonoo published a bulletin on the chemical composition of a large number of India foodstuffs. The Department of Agriculture, Mysore, also studied a certa number of foods known as famine foods. These studies have been of gre help to public health workers and those interested in nutrition and dietetic Today, we have information on more than 300 common Indian foodstu including cereals, pulses, fruits, nuts, tubers, leafy vegetables, spices, dai products and non-vegetarian foods. More articles of food are being studied l several institutions in the country. The amount of information alread available indicates that there are many different subsidiary foods which a rich in proteins, starch, fats, vitamins, etc., and what is required is the judicious combination and use to fight the mal-nutrition in the country. number of dishes having good nutritive value are already known and th should be consumed more frequently than at present throughout the yea New recipes which would appeal to the public taste have been and are bei worked out. Some of the subsidiary foods from which nutritive dishes can prepared cheaply and which are of special interest to Mysore are brie described here.

"*Kosambaries*" and "*Usalis*":—It is common knowledge that proteins e very necessary for building up the body and for making good the loss of ssue which takes place during the various physiological processes. It follows erefore, that our diet should be rich in protein. However, this is not always e case especially with those whose main diet is rice which is known to be one the poorest in protein among cereals. The rice diet requires therefore to be pplemented with other protein containing foods. Among the comparatively eap foodstuffs of vegetable origin, pulses and nuts are very rich in protein, me being even richer than meat. Almost in every house there are occasions nen "*Kosambaries*" prepared from various pulses like blackgram, bengal am, etc. are served. Similar is the case with "*Usalis*" prepared out of rminating grains of pulses Modern knowledge of nutrition shows that this an excellent practice since these foods are rich in protein and also can pply the necessary vitamins to the body. The use of these dishes should erefore be widely popularized.

"*Rajakere*" or "*Rajgira*":—Another important foodstuff is "Rajakere Horigire" (*Amaranathus paniculatus* L). (Photo) It is of special interest Mysore since 3 different varieties, black, white and yellow seeded, are grown small areas of the State. Its young leaves are also eaten as a vegetable *ile dantu*). Its grains which are usually consumed in rural areas in the ate and by the poorer classes of people especially in Bombay, Madhya radesh and Uttar Pradesh are found to be a good source of high class otein. They contain also calcium and phosphorous, both of which are very portant for our metabolism since most of the calcium in the bones is posited as calcium phosphate. The net result of this is that 'Rajakere' ains are very good for promoting growth; in fact, they are 3 times as good as ce in this respect. One of the usual ways in which these grains are consumed is puff them in a hot bowl and prepare "*Laddus*" from the puffed grain mixing own sugar or jaggery, Such "*Laddus*" are actually sold in some towns for few pies each. Alternatively, the puffed grain can also be elegantly served a porridge (with milk and sugar) which can satisfy the most delicate palates. he grains have a fairly thick seed coat (and that is why they should be eaten a puffed state and not raw) and it contains crude fibre which provides roughage" good for the mechanics of digestion and for counteracting any ndency to constipation. Physiologically speaking, therefore, the grains of Rajgira' (food for kings) is a multi-purpose subsidiary food which deserves ecial attention to be paid to its cultivation and use on an extensive scale.

There are a number of other foods which are rich in protein, but it may e mentioned that the value of the protein depends on its "digestibility" or biological value." If a protein is undigestable, it is not good for body-ilding. It has been found that the more the protein in a foodstuff resembles, its chemistry, the protein in animal tissues, the more its digestibility or the gher its biological value. Proteins in non-vegetarian foodstuffs have generally higher biological value than those in many vegetarian foods. It is therefore be recommended that, whenever possible and when religious or other senti-ents do not interfere, a combination of proteins from vegetarian and non-egetarian foods should be made in our menus. Workers in nutrition and ractical dietetics insist, therefore, on the inclusion of small quantities of ubsidiary foods of animal origin like eggs, fish, meat, etc., even in the "cheap alanced diets" especially for growing children. In the case of persons who do not take or are averse to non-vegetarian food, subsidiary foods from vegetable ources, such as those mentioned above and of which the nutritive value has een scientifically studied should be consumed to make the diet more whole-ome.

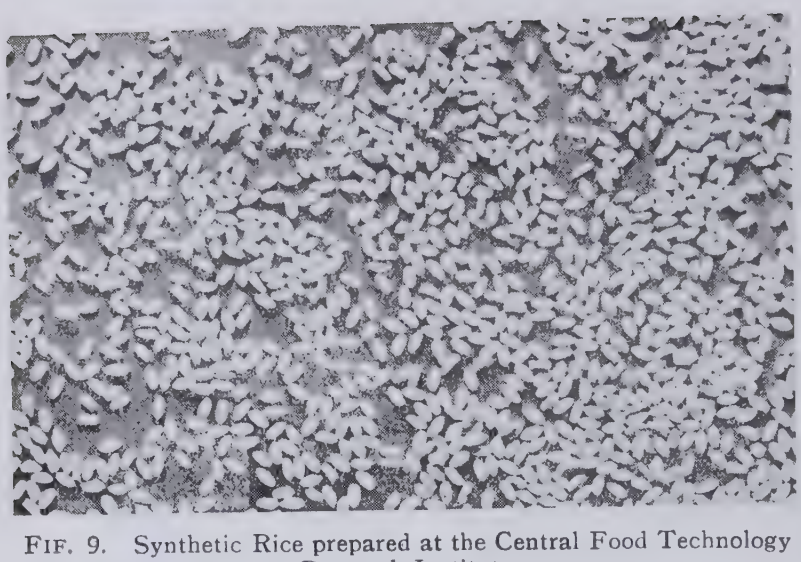
Tapioca.—Among subsidiary foods rich in carbohydrates, the mos important are the so-called inferior millets, certain starch-supplying foods an tuber crops, such as potatoes, sweet potato, and particularly tapioca which ha been studied intensively in recent years. It may be remembered that car bohydrates are the main source of energy for the body. Of the 3 tuber crop mentioned above, tapioca contains the highest percentage of carbohydrate about 39%, and has as much calcium as in "whole wheat." These finding have, of late, brought tapioca into prominence as a valuable subsidiary foo One of the easiest ways of utilizing tapioca in any household is in the form o vegetable instead of potato which is comparatively costly these days. Tapioc vegetable, curries, *purees*, etc. can be prepared as from potatoes. Experienc shows that these dishes are relished the same way as those prepared fro potatoes. As to the availability of tapioca for the common household, it ma be mentioned that, unlike potato, tapioca can be grown easily in the kitche garden even as a hedge plant. The tubers are formed 9-10 months aft planting. Each plant will yield 10-12 tubers which will supply enoug vegetable for a few days. Every house having a patch of garden should there fore introduce tapioca as a new vegetable for the kitchen garden. Tapioca very easy of cultivation and will thus substantially increase the supply home-grown vegetables.

Synthetic Rice.—It is well known that there is at present a shortage cereals in the country. Although every effort is being done by the Gover ment to increase the production of food grains and also to import them large quantities from other countries, the shortage of staple grains, of rice particular, has been persistent over several years. Tapioca being essentially starchy food like cereals, attempts were made to find out to what extent it c replace the staple cereals in the diet. The animal and institution feedi experiments conducted at the Central Food Technological Research Institu Mysore, proved that tapioca can be profitably substituted for rice in our diet to 25%. This laid the foundation for the "Synthetic Rice". Neverthele tapioca was found to contain negligible amounts of protein and therefore if were to be consumed in large quantities as a bulk food in place of rice, the d would become ill-balanced. This difficulty was overcome by combining, in Synthetic Rice, 80% of tapioca (starchy) and 20% of groundnut cake flo (proteinaceous). This makes the Synthetic Rice the same as rice in composition. It may be added that, by processing, the Synthetic Rice can made even more nutritious than rice, but then its price which is at prese lower than that of rice will increase. The synthetic rice of the compositi mentioned above tastes like rice in all the preparations. Dishes prepared fr Synthetic Rice and served in "Annapoorna" cafeterias on several occasi proved to be very popular. The Synthetic Rice is not meant to replace r when rice is available, but only when the latter is in short supply. On acco of the continued shortage of rice in the country, the production of Synth Rice on a large scale by automatic mechnical means is now under the act consideration of the Government. The example of the Synthetic Rice sho how two or more selected subsidiary foods, by proper processing, can be c verted into a nutritive food capable of even replacing a staple diet in times emergency.

"*Mysore Flour*"—From the basic materials used for the preparation Synthetic Rice, another product called the "Mysore Flour" has been develo at the Central Food Technological Research Institute, Mysore. With processing of this product reduced to the minimum, the Mysore Flour is far the cheapest foodstuff yet produced with tapioca and groundnut. supplies, at a very low cost, enough nourishment to subsist for people

IF. 7. Singhara (*Trapa bispinosa*) showing two types of leaf and fruit (F)

FIG. 8 Tapioca tubers



FIF. 9. Synthetic Rice prepared at the Central Food Technology Research Institute

FIG. 10. Rajgira (*Amranthus paniculatus*) plant and its inflorescence.

stress-affected areas. During 1952 and the early part of 1953, *Muddhe* " or gruel prepared from Mysore Flour were served with *dal* soup about 5,800 people at 6 Famine Centres in Rayalseema District at a cost t exceeding 2 annas per head per day. The health observations carried out the people fed on Mysore Flour indicate that it is a valuable " Famine ood " and can serve as a standby in famine and semi famine conditions. ie ingredients of the Mysore Flour and the simple method of their preparaon make it possible for people in distress areas to produce this food in their spective localities.

Groundnut and its products.—The groundnut which forms part of the nthetic Rice or Mysore Flour is a very nutritive subsidiary food in other ays. It contains 40% fat and fat is a concentrated source of energy for the dy. It is well known that the average Indian diet is rather poor in fat. ich a diet is also often deficient in fat-soluble vitamins. Groundnut is one the richest sources of Vitamin B_1 and nicotinic acid besides containing oflavin. So far as these vitamins are concerned, groundnut is verily the or man's vitamin tablet. In the U.S.A., where the food value of groundnut fully realised, a number of groundnut products have entered into the dietary the people. The Peanut (groundnut) Butter is a very popular article of od. The well known American Scientist, G. W. Carver, has shown more an a hundred different ways of consuming groundnut, in soups, *consommes*, *rees*, bread, rolls, cakes, puddings and other miscellaneous sweet and salty acks. In our own country, one of the popular ways of eating groundnut is the form of " *Gurdani* " prepared with sugar or *gur*. It will be seen from e above that it is a highly nutritious product and its use should be popularized. he *gur* in the Gurdani will also add to the mineral constituents of the food hich are required for normal nutrition. Apart from this particular product hich is eaten usually in rural areas, it should be recommended generally that account of the high nutritive qualities of the groundnut, it should be used an adjunct to as many vegetable, *dal* and other preparations as possible. very housewife will know that this will only add to the flavour and palatability the dishes.

Vegetable Milk.—There is plenty of groundnut in India which stands st among the groundnut-producing countries in the world. On the other nd, there is a shortage of milk in various parts of the country. The mmonly accepted standard for the consumption of milk and milk products 20 oz. per adult per day. Actually, the average consumption of these oducts in India is much below even half this quantity. In order to meet this ortage of milk, therefore, the Central Food Technological Research Institute, ysore, has evolved a method of producing from groundnuts a deodorized d fortified vegetable milk which is as nutritious as ordinary milk. By this ethod about 8 lbs. of milk can be had from 1 lb. of groundnuts. A lb. of rtified vegetable milk costs about 3 annas which makes it cheaper than cow's buffalo milk. Curd or buttermilk prepared from the vegetable milk are distinguishable from the natural products. The vegetable curd is being pplied daily to hotels and restaurants in Mysore City for the past several onths and has already become very popular. The product can be used to ise the level of consumption of " milk products " at a comparatively low cost here milk is available only to a limited extent or where curd and other milk oducts are not available at all.

" *Singhara* ".—Another article which forms a populur subsidiary food here there is plenty of catchment water as in the Konkan Belt of the ombay State, Bengal, Bihar and especially Kashmir, is " Singhara " (*Trapa*

bispinosa). (Photo) The fruit of this aquatic plant contains about 70% carbohy drates and, when dried and ground, yields a flour which can be used in the sam manner as cereal flour. Animal experiments have confirmed that when ric is replaced by "Singhara" the overall nutritive value of the diet is increased Besides, the dried "Singhara" contains more phosphorous as compared wit cereals, an element which is only second in importance to calcium for ou metabolism. In Kashmir and a few other States in North India, the fruit i raised as a crop and has served as a standby in times of food shortage. I Mysore State where there is a pond, tank or a lake for almost every squar mile of the surface, the introduction, cultivation and use of this valuable plan are to be recommended.

Miscellaneous.—There are a number of other food articles which can b used with advantage to supplement our daily diet. The potato and the swee potato to which a reference has been made above, as well as cooking plantain raw jack fruit, raw papayas and a host of other articles can be used a vegetables. Fruits as a class are costly commodity, but the cheap and commo fruit "*Amla*" or *Nellikayi*" (*Phyllanthus embica*, L.) growing in Mysor which contains 20 times as much vitamin C as orange juice, is to be special recommended. There are a few foodstuffs which are a good source of vitam C and among these are green vegetables and salads especially "*dantu* (*Amaranthus gangeticus*) "*Nugge soppu*" or Drumstick leaves, "*Yele kosu* or *Motte kosu* (Cabbage), "*Basale soppu*" (Spinach), "*Kothambarie* (Coriander) and Parsley (*Petroselinum sativum*), etc. which are plentiful available in Mysore. These should form a regular item in our diet. Th so called inferior millets, *Ragi*, *Bajra*, *Cholam* (Indian Millet), are high esteemed foods both for their taste and nutritive qualities. The whole range animal foods such as eggs, meat, fish, poultry and various game deserv particular attention and should be used, whenever conditions permit, as usef supplements to the vegetarian diet.

Surveys carried out in various parts of India show that either owing the scarcity conditions in certain areas or owing to the basic cause of povert or also to sheer lack of knowledge of the principles of nutrition, our diets a mostly insufficient and ill-balanced. There is a long list of diseases, comm in India, which are due directly or indirectly to mal-nutrition. The hum body has such a remarkable degree of tolerance that most of the time m hardly realises that his body is being starved on account of an "ill-balanc diet." Even when poverty prevents from taking a diet which satisfies t modern standards of nutrition, it is possible to improve the diet by a judicio use of subsidiary foods which are usually much cheaper than the staple on Fortunately, in India, a wide choice of subsidiary foods is available and it w be seen from the brief account given above that they are suppliers of t various "Food Factors" necessary for good nutrition. A number of excelle dishes can be turned out from the subsidiary foods in the hands of a housew with a culinary bent of mind. It is advisable, however, that subsidiary foo which have been well studied and recommended by nutrition experts should used in preference to those which are completely new or the least familiar. is important, therefore, that the nature and the food values of subsidiary foo should be made as widely known as possible. A free and frequent use of su subsidiary foods which are now available in Mysore Stare in increasi numbers will remedy the conditions of mal-nutrition and also relieve pressure on staple foods in times of food shortage.

HE WHO PLOUGHS AFTER HARVEST HAS NO SPACE TO STORE THE GRAINS.

FOOD INDUSTRIES FOR RURAL AREAS

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India being essentially an agricultural country, the rural population is ore than 85%. Besides, in many areas the rural population remains idle for good portion of the year. The necessity for harnessing this abundant supply man power is recognised by the authorities as the immediate need of the untry. In most areas during periods of glut, production of fruits, vegetables d other crops, considerable quantities go to waste as the people who grow em are not conversant with methods of preserving them. Besides, there are ny other crops like growing of tapioca and other occupations all of which ld very good returns to the rural folk. Thus, it is in the national interest at both the abundant supply of man-power, and raw materials especially ring periods of over-production should be made use of for the benefit of the al folk in particular, and the country at large. This problem deserves siderable attention especially in the present context of food scarcity in the untry. If the villager could conserve perishable food materials and also try produce more types of new materials, there is no doubt that the country ll be self-sufficient with regard to food in a short time. To this end, food lustries on a cottage scale in rural areas will play a very important role.

The immediate needs therefore are: (i) to improve the existing food lustries in the countryside, (ii) to develop such new industries for which raw terials are plentifully available in those areas, and (iii) to start the growing such agricultural crops which form useful raw material for new food lustries. In all this, imparting of the "know-how" of various methods volved is very important.

l milling

In the rural areas there are already some industries which are working cording to age-old methods. The village *ghanni* which is used to express from oil seeds needs to be improved. The oil cake left after expression of contains about 15% of oil. With modern expeller machines, a very high portion of oil could be recovered leaving a cake containing less than oil. Small-scale efficient expellers are now manufactured in India and are ailable at moderate prices. Such efficient means of production will give e villager more oil for his produce and also augment the present supply of ible oils. Further, at present, no attention is paid to the cleaning of oil eds like groundnut kernels before expressing oil. This results in a cake full dirt and other foreign matter. On the other hand, if the kernels are roughly cleaned and they are divested of the cuticle (by slightly roasting e seeds) and crushed, the cake obtained will be good for human food. This ke, can be ground into flour and used with advantage in admixture with ner cereal flours. Such a procedure will give additional food to the llager and greatly benefit him.

ır making

Gur making is an important rural industry which exists in practically ery village where sugarcane is grown. Here, the problem is that of getting e maximum juice from the cane by employing better crushers and maximum ld of *gur* adopting improved methods of making *gur* so as to produce a oduct, which has an attractive colour, which is free from foreign matter and th better keeping qualities. In some rural areas brown sugar is also

produced. But this is not widely practiced. Since *gur* and brown suga contain all the constituents present in the cane-juice, these products an considered nutritiously better than factory-made white sugar. Every effor requires to be made to popularise better methods of extracting the juice an also making better quality *gur*. In this connection, the work that is bein done at the Indian Institute of Sugar Technology, Kanpur, on various aspec of this problem requires to be widely made known in the country side.

Dairy Industry

Dairy Industry plays a very important role in the economy of the village Sale of milk and butter which a villager produces gives him enough retur to meet his other daily requirements of auxiliary food materials and othe necessities of life. But, methods as at present practiced of butter making an disposal of surplus milk are far from satisfactory. By adopting bette technique he can produce very good quality butter.

Ghee making

Moreover, it is observed that the *ghee* made in the villages is not o uniform quality. This is again due to indifferent methods adopted fo clarification. The villager will benefit a great deal if he adopts improve techniques in all his processes.

Poultry forming

Every villager owns a few poultry birds, but the maintenance of th poultry is not practiced according to scientific principles. During an epidemi all his animals are wiped out resulting in a considerable loss. Further, th eggs produced are not graded. Practically no attention is paid to the vario aspects of poultry farming, which is an important factor in the rural econom It is most necessary that the ' Know-how ' of better methods of poult farming should be made known to villagers.

Fruit and Vegetable preservation

Besides the above types of industries, there is no other important foo industry in which the villager is at present engaged. The rural populatio could usefully employ themselves especially where certain types of crops lik fruits and vegetables are grown abundantly. The conservation of such cro is all the more important. In one of the articles in this publication metho of conserving fruits and vegetables in the form of canned fruits, jams, jelli and curried vegetables are given. Besides, fruits like oranges, mangoe passion fruit, lime fruit, etc., could also be turned into squashes and cordials simple means and bottled. Raw mangoes, plenty of which fall off befo ripening on account of heavy storms could be usefully turned into pickles adopting strict hygienic principles. Jack fruit, which is abundantly grown *Malnad* areas of Mysore State, is at present utilized for conservation to limited extent. A delicious squash could be prepared from this fruit. T fruit could also be dried in the form of sheets. Cashewapple much of whi go to waste in cashew plantations could be turned into a number of useful a delicious products like cashew juice, candy, pickle and jam. Prop utilization of banana fruits either by drying the whole fruit from whi banana flour or banana figs could be prepared would greatly benefit t villager where these are grown in abundance. The felled banana-stem af cutting the bunch is usually wasted. It has been shown that by suitab processing each stem will yield 1-1½ lb. of good quality starch. In areas whe bamboos are grown, such of the tender shoots as are not like to develop into tall bamboos can be converted into delicious produc

e candies, pickles and chutneys by relatively simple methods. A ıple technique has also been worked out for the preparation of vinegar on ne and cottage scales from sugar-bearing materials like fruits and molasses. ith a simple equipment costing about Rs. 30 about two gallons of vinegar day could be produced. For the preparation of these and other similar ducts on cottage and home scales, simple methods have been standardized.

go and Tapioca Soji

Among the other important industries which can be started in the rural a, tapioca chips, starch, globules (*sago* and *soji*) may be mentioned. pioca, a tuber crop, which grows practically on any soil, does not require ch rainfall and yields much more than other crops. It can therefore be fitably grown in the rural areas. The tuber is ready for harvesting in out 9—12 months after planting the "setts." The tubers, after they are g out, are divested of their outer skins, cut into thin slices, washed and sun ed. These chips could be used in the same way as potato chips in culinary eparations. For the preparation of tapioca starch, the deskinned tubers e rasped and the mixture is taken up with water and sieved through a 120 sh sieve (or fine muslin cloth) to separate the fibre from the starch. Starch allowed to settle in tanks or tabled with water and finally dried in the sun. ie dried flakes could be ground to any mesh, thus yieding starch useful for a riety of industrial purposes. Tapioca globules (*sago*), an important cottage lustry in Salem (Madras), are made from tapioca starch. The process nsists in preparing the dough of proper consistency, pressing it through a ate having small holes and rolling the small particles to the shape of globules. iese are then carefully roasted in open pans to partially gelatinize the obules. This industry has made rapid progress during recent times. Tapioca *ji*, which can be used in the same way as wheat *soji* (*Semolina*) is being epared in large quantities in Salem and other areas where tapioca is grown undantly. The tapioca, chips mentioned above, are partially cooked in eam, dried and coarsely ground to obtain tapioca *soji*. These products ve been found to be very good substitute foods. The tapioca products ve already become quite popular and have a ready market. However, the ethods of their preparation as at present practiced require to be rationalized d made more hygienic. Further, suitable mechanical appliances for these dustries on a cottage scale needs to be evolved. It is understood that tapioca bers are now grown in certain *Malnad* areas in Shimoga District (Mysore ate). In these areas tapioca processing industries could be immediately arted with considerable profit to the villagers.

ee-keeping

Bee-keeping is another cottage industry which the rural folk could easily ke up. Experience in Uttar Pradesh has shown that each hive could yield 8 lbs. of honey in about six months. Honey is an important infant and valid food and it will be very useful if every household in rural areas aintains one or more bee-hives.

The above are some of the food industries which suit the rural conditions are existing in India today. With the modern ways of living entering pidly into the life of the villager, and the rural electrification programmes of e various Governments, these individual food processing units may well form e feeding lines, as in Japan and Switzerland, for bigger factories situated in e town.

The development of industries on cottage scale in rural areas has been ıply stressed in the Five-Year Plan for India. The Cottage Industries

Board of the Ministry of Commerce and Industry, Government of India, ha recently impressed upon the various State Governments the need for devotin greater attention to the development of cottage industries in rural areas. I this regard, every one will have to play his part. The Central Food Techno logical Research Institute, Mysore, has published a number of leaflets dealin with the preparation of several food products on home and cottage scale. start will have to be made now to utilise all available resources, especially i view of the low economic level of the villager and the food scarcity in th country.

HOME CANNING OF FRUITS AND VEGETABLES

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A variety of food crops are grown all over the country and among thes fruits and vegetables are the most perishable ones. Consequently, the preservation is of utmost importance in our economy especially in the presen context of the scarcity of food and malnutrition. Fruits and vegetables a good sources of vitamins and minerals which are very essential in our norm diet. Fruits and vegetables are seasonal and conserving them in prope form will be of great benefit not only to the producer but also to the publ at large. By this means, in their preserved form, fruits and vegetables cou be made available all round the year and also in areas where thes commodities are in short supply. The most important method of preservin them is by canning in suitable forms such as, fruits in syrup, fruit juices, jam jellies and marmalades and vegetables in brine, curried vegetables a vegetable soups. At present there are a number of factories in India most situated in urban areas, producing a variety of canned products. Thes factories depend for their supply of fresh fruits and vegetables on orchard situated far away, with the result that during their transport a good proportio of these highly perishable commodities become unfit for canning. It i therefore, obvious that canning on a cottage-scale at places where the frui and vegetables are grown in abundance and on a home-scale where these a not grown in such large quantities, will be vety advantageous.

During periods of glut, considerable quantities of fruits and vegetables g to waste. Canning them on cottage-and home scales will be the mo effective way of saving wastage, besides adding to the economy of the rur areas. By this means, the producer will also save both in time and labo for transporting these highly perishable commodities to distant marke The small-scale canning units situated in rural areas will be able to obta their requirements in respect of fruits and vegetables in the fresh state a at very economic prices. This will help these units to produce high quali canned products at low costs and thus make them available at prices within t reach of the common man. These cottage-scale units when properly develop may well act as feeding sources for factories situated in the urban area Home-scale canning which will obviously be very economical, can be adopt by every housewife and the seasonal fruits and vegetables conserved in suita forms according to the requirements of the family and utilized during the re of the year. Methods of canning are relatively simple but in order to produ good quality products having long storage life, certain essential precautions a

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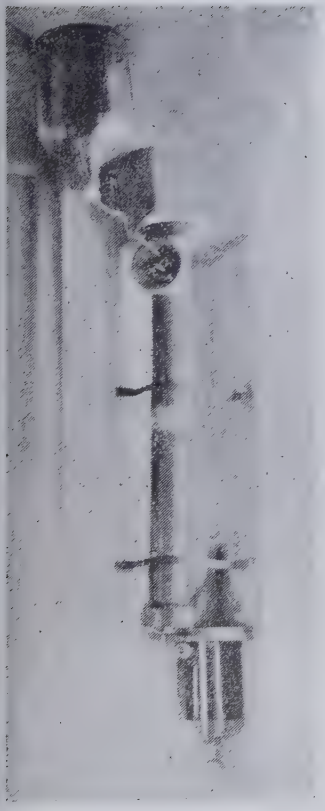

FIG. 11. Home Scale Vinegar Generator

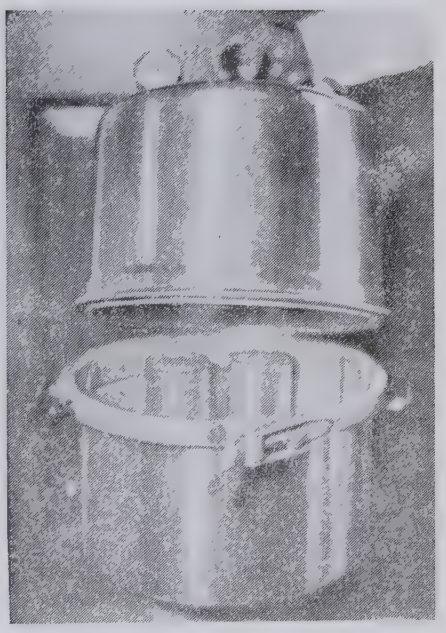

FIG. 12. Pressure Cooker (Burpee type)

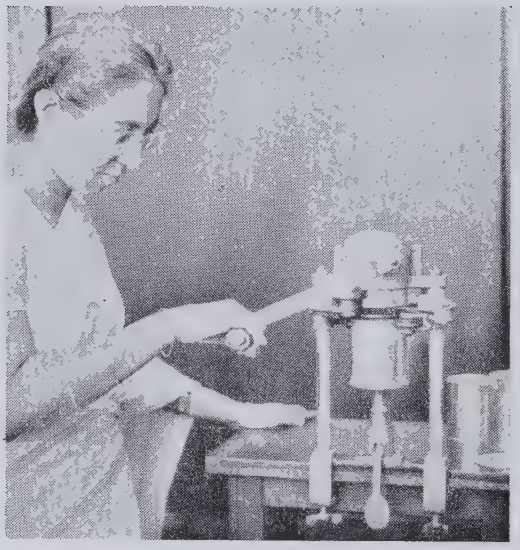

FIG. 13. Home Can Sealer

cessary, *viz.* (i) *all the canning operations should be done under strictly gienic conditions*, (ii) prolonged washing or soaking of fruits and vegetables water should be avoided (iii) the various operations should follow in quick ccession, and (iv) use of copper, iron or chipped enamel vessels should be oided.

The various steps involved in the preparation of canned products are sentially the same, *viz.*, securely sealing the containers so as to make them r-tight to prevent contamination from outside and heating them in the epared form to appropriate temperature in suitable containers with the object destroying the enzymes and micro-organisms (moulds, yeasts and bacteria). ne following is a brief outline of the methods for the preparation of various pes of canned products :

Selection of raw material : Sound fruits and vegetables with proper aturity and ripeness should be used, *e.g.*, only the best fruits at the firm ripe age (with fully developed aroma and bright colour) are considered most itable for canning them in syrup, while slightly unripe fruits along with ripe uits could be used for jams, jellies and marmalades. Fruit juices could be epared from fully ripe fruits even though they are not firm. For the cann- g of vegetables in brine or in curried form, they should be mature and tender d possess an attractive colour.

Preliminary treatment.—The well graded fruit or vegetable is washed oroughly in running water in order to free it from dust and foreign matter. 'here fruits or vegetables are obtained from plants sprayed with insecticides ey should be thoroughly washed with suitable chemical solutions *e.g.* washing 1 : 20 dilute hydrochloric acid is done for Bordeaux mixture sprayed aterial.

Preparation of (*a*) *Fruits in Syrup.*—The clean washed fruit is peeled red or pitted and cut into slices or pieces of suitable sizes. The prepared aterial is put into clean sterilised cans, the minimum weight of the filled fruit ing 18-20 oz. for A $2\frac{1}{2}$ size can. Hot boiling filtered sugar syrup of 35°-55° rix (depending upon the fruit and its maturity) is poured into these can aving $\frac{1}{4}$"-$\frac{1}{2}$" head space. Limited quantities of a suitable edible colour may added to the filling syrup to obtain a desired shade of colour. The filled can placed in boiling water with about 2" of its body remaining out of water. It allowed to remain there until the centre of the can shows a temperature of out 170°F. This process, known as " exhausting ", aims at driving away air ld by the fruit tissues. The tins so exhausted are quickly covered with the p lids and carefully seamed by means of a *Home Can Sealer* (a double amer) according to the instructions supplied with the machine. Sterilization the sealed cans is effected by keeping them in boiling water for 15-40 inutes depending on the nature and maturity of the fruit and the kind of pack. he sterilized cans are then cooled in running cold water and stored in a dry ace after labelling them. The various types of fruit which could be so nned are: some tried varieties of mangoes, *viz.*, *Badami*, *Safeda*, *Langra*, *anduri* ; pineapple ; jack-fruit ; pears ; grapes (seedless), etc.

(*b*) *Jellies and Marmalades.*—The clean washed fruits should be cut to thin small pieces and boiled with water (enough to cover the cut fruit) till e fruit gets softened and the extract gives a slightly sticky touch. The filtered xtract is cooked with 75-100% of its weight of sugar and a small quantity of

citric acid, if necessary, till a temperature of 221-222°F is reached. Som shreds of peel of oranges (previously boiled) are added a few minutes earlie in the case of marmalades. The finished product is poured into sterilize cans, covered with lids and immediately sealed. The cans are turned upsid down in order to sterilize further the lids, and then allowed to cool undisturbed In this way the product sets properly giving a sharp edge and quiverin movement when cut after the can is opened. The fruits particularly suite for jellies are guavas, papaya, apple, etc, and those for marmalades ar '*Satgudi*' oranges, '*khatta*' (large size lemon), grape-fruit, etc., since a these fruits contain greater proportions of pectin which is necessary to obtai a proper set in these products.

(c) *Jams.*—The small pieces of the sliced or cut fruit are softene if necessary, by heating in a small quantity of water and then mixed with a equal weight of sugar in the case of acidic fruits and with three fourths quantity of sugar and a little quantity (10-15 grains per lb. of fruit) of citr acid for sweet fruits. The mass is thoroughly macerated and cooked suitable pans, with continuous stirring, till a temperature of 221-223° is reached. The finished product is put into sterilized cans and the proce completed as above. All types of fruits such as mango, pineapple, appl pear, orange, berries of all kinds, could be used for the preparation of jams.

(*d*) *Fruit juices.*—Fruits like oranges, pineapple, apple, tomatoes, etc which yield a high proportion of juice are most suitable for the preparatio of canned juice. The juice is obtained by crushing the edible portion of th clean washed fruit in a wooden basket type press and then filtered through coarse muslin cloth. The filtered juice (as such or after proper blending vi 5% sugar in grape-fruit and pineapple juices, 1% common salt in tomato juic is then filled into sterilized cans (of the lacquered type for acidic fruits exhausted, sealed and sterilized as in the case of the preparation of fruits syrup.

(*e*) *Vegetables in brine*: Clean and sound vegetables are first divested their stalks and stems, peeled, shelled or cut into pieces of proper sizes, *i.e.*, for use in the home kitchen. These are then wrapped in a muslin cloth a immersed in boiling water for 2-5 minutes in order to soften them and al kill the oxidative enzymes which would otherwise discolour them. Th process is known as blanching. The blanched vegetables are put into steriliz cans, the minimum weight being 18-20 oz. of the prepared vegetable for A size can, and the interspace filled with boiling salt solution of 2-3% streng leaving a head-space of $\frac{1}{4}$-$\frac{1}{2}$". The filled cans are exhausted and seam after which they are cooked in a *pressure cooker* at 240°F (10 lbs. stea pressure) for 30-60 minutes depending upon the nature of vegetable and t pack. The steam pressure is released and the cans removed for cooling a stored in the usual way. Various vegetables like cauliflower, peas, carro beans, etc. are preserved by the above method.

If during storage of canned products any can is observed to have a blow appearance, it should be removed from stores and contents destroyed. T cause of spoilage may be (i) under processing or (ii) faulty seaming or (iii) t interaction between the can-metal and the fruit-acid resulting in the formati of hydrogen.

For the purposes of canning on home and cottage-scale simple applian together with their approximate prices and sources of availability are given

ppendix I. As a cottage industry the initial expenditure on these require-ents may justify the economy both in labour and time and also the ease cured for transporting the otherwise perishable commodities in the preserved rm to distant places. Further it may be stated that there are different sizes cans and the one recommended for home and cottage-scales is A-2½ size hich holds approximately 30 oz. of the finished product. In this size also ere are two types of cans, *viz.*, (1) Plain cans which are made out of the ain tinned steel plate and are used: (*a*) For canning green, yellow uits in syrup, (*b*) for jams, jellies and marmalades, (*c*) for fruit juices that e not deep coloured and acidic juices of which the colour is insoluble in ater, and (*d*) for vegetables in brine, curried vegetables, etc., (2) acquered (*R. enamelled*) Cans which have a golden coloured lining the inside surface and are used for canning deep coloured fruits (the lour of which is soluble in water) in syrup, acidic juices, and (3) acquered (*Sulphur resistent enamelled* Cans are used for canning of peas, rn, etc.

Several fruits like orange, mango, guava, pine-apple, jack fruit, papaya, nana, grapes, apples, etc. and vegetables such as peas, cauliflower, beans, matoes, carrots, etc. are grown in abundance in the State of Mysore and the ighbouring areas. These could, therefore, be profitably canned during the asons when they are plentifully available.

The canning of fruits and vegetables on home and cottage scales is still nknown to most of the people in our country. The immediate need is ssemination of the 'know-how'. For this purpose, the Central Food echnological Research Institute, Mysore has published a number of leaflets escribing the methods of various food products in simple non-technical nguage, a list of which is given in Appendix II. The Division of Fruit echnology of this Institute is continuously working out techniques for the reparation of new types of fruit and vegetable products and is also nducting a post-graduate Diploma course in Fruit Technology of 15 months' ration including 3 months' factory training. The Division of Information nd Statistics is engaged in the dissemination of the knowledge to the people (i) publishing leaflets on various new products as and when they are andardized, (ii) getting these leaflets translated into regional languages in hich direction they have secured the co-operation of the Government of ysore to have these leaflets translated in Kannada, (iii) answering enquiries om the public on various aspects of canning and preservation, and (iv) actically demonstrating the methods of preparation of various food products the important exhibitions.

One-fourth of the food of the rich goes to nourish them and three-fourths kill them—*Chinese Proverb.*

If man will but use his God given mind and brawn the earth will yield not ly enough rice and grass but cake and vitamins too—*John Boyd Orr.*

The Chinese word for PEACE (HO—P'ING) means food for every nth in a balanced way. Wherever in the world there is hunger there will little peace and wherever there is conscience little peace of mind.

APPENDIX I

(List of equipment required for Home- and cottage scale canning)

S. No.	Name of the article	Quantity or No.	Approx. Price Rs.
1	Basins (enamelled) ...	Four	10
2	Basket type press (wooden) ...	One	100
3	Buckets G.I. for water only ...	4	20
4	Can and Cork opener ...	2	1
5	Cans (reformed)—(30 oz. A2½ size. according to requirements ...	...	...
6	Can sealer (Burpee type) with spare parts ...	One	300
7	Citric acid (according to requirements) ...	Per lb.	3
8	Colours (edible) ...	2-3 oz.	1
9	Cooking pans (Aluminium 15–20 lb. capacity)...	6	20
10	Cups (aluminium) ...	2	5
11	Cylinders (graduated 500 cc.) ...	3	10
12	Family balance ...	1	50
13	Gloves (rubber) ...	4 pairs	15
14	Hearths (charcoal) ...	2	8
15	Hydrometers (brix) all ranges from 0°—90° ...	1 set	75
16	Ladles (wooden) ...	6	5
17	Plates (enamelled) ...	6	10
18	Pressure cooker (Burpee type) ...	1	300
19	Salometer ...	1	15
20	Stainless steel knives of all kinds (cutting, peeling, coring and pitting) ...	1 doz. each	150
21	Stove (kerosene or electric) ...	1	15
22	Thermometers (F. to 300°) ...	2	30
23	Tumblers (glass) ...	6	3
24	Pressure vacuum guage ...	1	40

Note.—1. Prices, as given above, are only approximate in view of the fac that they will keep on changing.

2. Cans and can sealing equipment can be secured from the Meta Box Co. of India, Calcutta, or through any of the branches i Madras, Bombay or Delhi.

3. Items of machinery including knives, etc., can be had from Foo Machinery Suppliers like Messrs. Gladwyn and Co., Hornb Road, Bombay or Gardners Corporation, Connaught Circu New Delhi.

4. Chemicals and Laboratory equipment available from all scientif stores.

5. Other items of every day use can be purchased from Hardware c General merchants in the local market.

APPENDIX II.

(List of leaflets published by the Central Food Technological Research Institute, Mysore.)

Home Scale Fruit and Vegetable Preparation Series:

1 Preparation and Preservation of Orange Squash
2 Do Lime or Lemon Squash
3 Do Lime juice Cordial
4 Do Lemon or Lime Barley Water
5 Do Mango Squash
6 Do Passion Fruit Squash
7 Do Fruit Syrups
8 Do Unfermented Apple Juice
9 Do Tomato Juice
10 Canning and Bottling of Fruits
11 Do of Vegetables in brine
12 Do of Vegetables
13 Drying of Fruits
14 Drying of Vegetables
15 Preparation of Jams
16 Do Mango and other preserves
17 Do *Petha* Candy
18 Do Guava Jelly
19 Do Orange Marmaiade
20 Do Sweet Mango Chutney
21 Do Guava Cheese
22 Do Tomato Ketchup
23 Do Mango Leather
24 Do Sweet Turnip Pickle
25 Do Mango Pickle in Oil
26 Do Lime and Green Chilli Pickle
27 Preparation and Preservation of Spiced Carrot Juice
28 Do Apple Cider
29 Do Grape Wine
30 Preparation of Vinegar
31 List of equipment (along with cost and availability) for cottage scale work
32 Preparation and use of Banana Chips
33 Preparation and Preservation of Cashew Apple Jam
34 Preparation of Cashew Apple Candy
35 Preparation and Preservation of Cashew Apple Juice
36 Preparation and Preservation of Cashew Apple Syrup

Substitute Food Series

1 Preparation of Soyabean Milk
2 Do Synthetic Grains
3 Do Groundnut Milk
4 Do Bamboo Candy
5 Do Bamboo Chutney
6 Do Bamboo in syrup
7 Do Bamboo in brine

SOME RECIPES FOR NON-CEREAL FOODS

By V. Balu

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Sweet potatoes, tapioca, Rajgira and groundnuts or defatted groundnu flour are important non-cereal foods that can be used for supplementing the daily diet. These foods are good from the point of view of a balanced diet Further, they can be produced in far greater quantities than cereals.

Sweet potatoes are rich in carbohydrates. They can be used with advantag to replace a portion of rice in the dietary. In fact, several palatable dishes can be prepared from them. Recipes for the preparation of sweet potat *halwa*, sweet potato *bondas*, sweet potato *bhajjies* and sweet potato chips ar given below:

Sweet Potato Halwa

Ingredients:

Fresh sweet potatoes 1 *pao*; sugar ½ *pao*
Cashewnuts ¼ *pao*; fresh cocoanut ½;
Ghee 1 oz; Cardamoms 4; a pinch of salt.

Method:

Wash and boil the sweet potatoes; peel and mash them very fine. Cho the cashewnuts and grate the cocoanut. Prepare sugar syrup b boiling. Add the nuts, grated cocoanut and the mashed sweet pota and cook for five minutes stirring well. Then, add ghee and cook fo another five minutes. Remove from fire and add cardamom (Elakk powder; mix well and allow it to set on a greased plate. Cut in small squares and serve.

Sweet Potato Bonda

Ingredients:

Black gram (to be soaked and ground soft)	...	3 oz.
Bengal gram (to be soaked and ground soft)	...	3 oz.
Bengal gram flour (Besan)	...	1 lb.
Rice flour	...	12 oz.
Maida (fine flour)	...	8 oz.
Sweet potatoes	...	3 lb.
Vegetable oil (for frying)	...	1½ lb.
Green chillies, limes and edible green leaves like *Murraya* (curry leaves)	...	8 oz.

Method:

Boil and mash the sweet potatoes. Mix with other ingredients. Ma small rounded pieces, dip in a thin paste of *maida* and fry in vegetal oil. About 100 pieces can be made from the ingredients given above.

Sweet Potato Pudding

Ingredients:

Sweet potatoes ½ *pao*; milk ½ lb. (1 pao); sugar 2 table-spoons; Vani essence 2-3 drops. (Eggs 2).

Method:

Wash and boil the sweet potatoes; peel and mash them very fi Mix the mash with milk in a baking pan, add sugar (two beaten eg for those who eat eggs) and 2-3 drops of Vanilla essence. Mix w

cover the pan, and bake for 10-12 minutes on slow charcoal fire, putting a few live charcoals on the top of the pan-cover, if there is no baking oven.

veet Potato *Bhajjies*

Ingredients:

Sweet potatoes, batter,* vegetable oil for frying.

Method: Wash and dry the required number of sweet potatoes, and cut them into thick rounds, dip them in the batter and fry in deep oil till golden brown.

* Method of preparing batter.

Ingredients:

Channa dal flour (Bengal gram) according to quantity of vegetables used, salt, chilli powder and turmeric powder.

Method: Sift flour into a deep plate, add chillies and salt to taste and turmeric powder. Mix gradually in requisite amount of water to make a thick batter.

veet Potato Chips

Wash and dry the required number of sweet potatoes, cut them into thin und chips and fry in oil to a yellowish brown tinge until crisp. Sprinkle ith pepper powder and add salt to taste.

RAJGIRA

Known variously as 'Rajakere', 'Ramdana', 'Horigire' and 'Rajdan', *maranthus paniculatus* is a small herb grown in Madhya Pradesh, Bombay ilgiris and parts of Mysore. The tiny seeds of the plant are thrice as utritious as rice and were the means of saving several lives in one of the mines in Mysore. The following recipe on the preparation of Rajgira candy ill be useful to the house-wife.

ajgira Candy

Ingredients:

'Rajgira' seeds 1 cup; sugar 2 cups.

Method:

Puff the 'Rajgira' seeds on a hot plate. Melt the sugar in a frying pan; melt slowly, stir constantly until melted; butter a shallow dish and cover bottom with the puffed seeds; pour the candy over them; set aside; when cool, break in pieces and serve.

TAPIOCA

At present, tapioca is grown on an extensive scale in Travancore-Cochin id some parts of Hyderabad, Assam and Mysore. It is a fairly cheap and utritious food. Its calcium content is high and it will therefore be a good pplement to the Indian diet. To popularise the use of tapioca, several cipes have been worked out; a few are reproduced below:

(Wash tapioca roots and peel both skins—the thin upper brown skin and the yellowish thick skin under it. Cut into chips $\frac{1}{8}''$ thick and use like any other root vegetable for preparing tapioca curry (*palya*), tapioca chips, tapioca *sagu*, tapioca *vangibhath*, etc.)

Tapioca Curry (*Palya*)

Ingredients:

Tapioca slices 2 lb.; grated fresh cocoanut $\frac{1}{2}$; green chillies 4; onions 2; turmeric; salt to taste; lemon; black gram 1 teaspoon; mustard $\frac{1}{2}$ teaspoon; red chillies 2; curry leaves; vanaspati or ghee.

Method:

Boil the tapioca chips in about 5 times the quantity of water. When soft drain off the excess water. Mash into small bits and set aside. Heat oil or ghee and fry in it, mustard, black gram, *dhal*, chillies (split lengthwise into halves), chopped onions, turmeric and curry leaves. Add to this the mashed tapioca and grated cocoanut and mix well.

Tapioca Chips

Wash the required number of tapioca roots, cut them into very thin round chips and fry in deep oil to a yellowing brown tinge until crisp. Sprinkle pepper powder and salt to taste.

Tapioca *Sagu*

Ingredients:

Tapioca slices 2 cups; grated fresh cocoanut $\frac{1}{2}$; green chillies 6; onions 2; turmeric; salt to taste, and tamarind (size of $\frac{1}{4}$ small lime). Black gram 1 teaspoon; mustard $\frac{1}{2}$ teaspoon; red chillies 6; curry leaves, vanaspati or ghee.

Method:

Boil the tapioca chips in about 5 times the quantity of water. When three-fourths cooked, add tamarind extract and boil till slices are quite soft. When soft, drain off the excess water. Mash into small bits and keep aside. Heat ghee and fry in it mustard, blackgram *dhal*, chillies split lengthwise into halves, chopped onions, turmeric and curry leaves. Add to this the mashed tapioca and grated cocoanut and mix well.

Tapioca *Vangibath*

Ingredients:

Tapioca 2 lb.; brinjals 4; ginger 1 inch; green chillies 5; turmeric powder $\frac{1}{4}$ teaspoon; oil 4 teaspoon; coriander leaves 1 bunch; *vangibath* masala 2 teaspoons; mustard seeds 1 teaspoon; black gram *dhal* 1 table-spoon; Bengal gram *dhal* 1 teaspoon; cashew nuts 10; salt 2 teaspoons; asafoetida; curry leaves; grated cocoanut 1 table-spoon.

Method:

Boil the tapioca chips in about 5 times the quantity of water. When soft, drain off excess water. Mash into small bits and set aside. Heat oil, add mustard, Bengal-gram *dhal*, Black gram *dhal*, cashew nuts, curry leaves and fry well. Then, add chopped ginger, coriander leaves, turmeric powder and salt. After 5 minutes, add the *vangi bath* masala, grated cocoanut, asafoetida and mashed tapioca. Before serving a few drops of lime juice may be added.

GROUNDNUT AND GROUNDNUT CAKE FLOUR

Groundnut compares favourably with wheat in its chemical composition d is superior in vitamins of the B group. Its protein is of high biological lue and is almost similar to that of meat. It is rich in minerals and is also rly cheap. The use of groundnut, or groundnut cake flour, obtained from operly cleaned seeds, will therefore be an ideal addition to the poor South dian diet. Candy, *Chapaties*, bread and *dosa* are some important items our menus ; the following recipes will therefore come in handy.

roundnut Candy

Ingredients :

Sugar 2 cups ; groundnut 1 cup.

Method :

Melt the sugar in a frying pan ; melt slowly, stirring constantly until melted ; butter a shallow dish, and cover bottom with the roasted and cleaned nuts ; pour the candy over them ; set aside ; when cool break in pieces, and serve.

roundnut Cake Flour *Chapaties*

Ingredients :

Atta (wheat flour) 4½ *chattaks* ; groundnut cake flour (defatted) ½ *chattak*.

Method :

Sieve the mixture of flours, mix with water and make into a soft dough. Keep aside for an hour, knead well and roll into thin *chapaties*. Bake them on a hot plate, over a good fire (About a dozen *chapaties* can be prepared from the ingredients given above).

roundnut Cake Flour Bread

Ingredients :

Groundnut flour (defatted) ¼ *chattak* ; *maida* 2 *chattaks* ; sweet potato flour ¼ *chattak* ; salt to taste, water to mix ; fermenting matter (hops).

Method :

Sieve and warm the flours and mix all the ingredients into a soft dough. Leave aside in a warm place in a greased baking tin for an hour or so for fermenting and then bake in a hot oven till it rises to double its volume and the top of the bread turns brown.

roundnut Cake Flour *Dosa*

Ingredients :

Black gram flour ½ cup ; rice ½ cup ; groundnut flour (defatted) ½ cup ; salt to taste ; water to mix.

Method :

Clean and soak *dhal* and rice separately. Wash well and grind them fine separately. Add groundnut flour, salt and a little water and mix well into a thin batter. Leave it overnight for fermenting. In the morning beat the batter well and prepare '*dosas*' on a '*dosa*' plate.

SHORT PARAGRAPHS ON THE LOCATION AND ACTIVITIES OF THE FARMS AND NURSERIES UNDER THE CONTROL OF THE GARDENS DEPARTMENT

By the Superintendent, Government Gardens

1. BANGALORE

The plant nursery at the Government Botanic Gardens is the main nursery where plants of horticultural and economic importance are introduced acclimatised and propagated. Besides, experimental work on fruit, vegetable and floriculture also is done here.

Horticultural Farm at Koramangala is situated about 6 miles from the Bangalore City Railway Station and is next to the Indian Dairy Institute. Both European and Indian vegetables are cultivated here to perfection under sewage water. Rhodes grass is grown under sewage and supplied to cattle owners (owning mainly milch cattle) is Bangalore, thus an attempt is made to solve milk problem in the city to some extent.

2. MYSORE

Avenue nursery attached to the Lalithamahal gardens is situated 4 miles from the Railway Station. It was started in 1930 and is mainly grown with fruit and avenue plants for planting in rural areas.

The Demonstration Orchard at Krishnarajasagara is 2½ miles from Krishnarajasagara Railway Station below the well known K. R. Sagara dam. It is 13½ miles from Mysore towards north end of K. R. Sagara connected with a fine motorable tar road. The orchard was started in 1930. It was started for the experimental cultivation and propagation of tropical, sub-tropical and temperate fruit plants. Besides, trials of some economic plants are also in progress, chief of which is the cultivation of Patcholi.

3. MANDYA

Fig Demonstration Farm, Ganjam is situated about 1½ miles from Srirangapatna Railway Station and about a mile from the Mysore-Bangalore Road. The farm was started in 1947. The object of the farm is to demonstrate the cultivation of the fig plants to local growers in Ganjam village which was once famous for fig gardens and to propagate fig plants for supplying to rural areas.

The Horticultural Farm, Maddur, is situated about 2½ miles from the Railway station. It is adjoining the Mysore-Bangalore Road close to Maddur town. The farm was started in 1942. It is both a vegetable and fruit farm. There is also an avenue nursery. Seeds of European and Indian vegetables are grown and fruit plants are propagated for supplying to growers.

4. HASSAN

The District nursery at Hassan is situated a mile and a half from the Hassan Railway Station in the breached tank bed of Kattinakere. It is adjoining the Maharaja's Park and is close to the Bus Stand. The area of the nursery is about five acres and is temporarily leased out from the Municipality. The activities are confined to the propagation of fruit seedlings and the cultivation of vegetables. Besides economic and avenue plants are also raised. Tapioca cultivation is undertaken on a large scale here.

5. TUMKUR

Horticultural Nursery at Tumkur is situated on the Bangalore-Haribar Road about 1½ miles from the Tumkur Railway Station. The nursery was started in 1952 with the object of raising fruit plants and vegetable seeds for supplying in Tumkur District. Distribution of European vegetables.

6. CHITALDRUG

The District Horticultural nursery at Chitaldrug is 8 miles away from Chitaldrug and 132 miles away from Bangalore on the Bangalore-Dharwar Road. The nursery was started in 1950 for propagating fruit plants and vegetable seeds for distributing in the district.

7. CHIKMAGALUR

The District Nursery is situated about one mile away from Chikmagalur town and 25 miles from Kadur the nearest Railway Station on the Kadur-Chikmagalur Road. The nursery was started in 1949 for raising fruit plants particularly good varieties of Citrus, Allahabad Guavas, and Mango varieties. During rainy season European and Indian vegetables are cultivated for demonstration purposes.

8. SHIMOGA

The District Horticultural nursery at Shimoga is situated two furlongs from Shimoga Railway station on the banks of Tunga-Bhadra river. The nursery was started in 1948. A collection of all the varieties of Bananas have been planted for multiplication purposes.

ARECANUT CULTIVATION IN CHITALDRUG TALUK

By B. A. Revappa, L.Ag.
Agricultural Inspector, Chitaldrug

The arecanut cultivation in this taluk is largely confined in Bheemasamudra and Bharamasagara taluks *atchkats* coming under well irrigation in Godabanahal, Medehalli and Kolahal villages. It is grown purely as irrigated crop since this tract has a very scanty rainfall.

Climate and Soil.—The arecanut palm flourishes well even in this high temperature zone, sometimes rising upto 102 degrees. The rainfall in this area is between 20-25 inches, mostly favoured in *Hingar* season. The soils are mostly red coloured, fertile clayey loams, free from rock. It is grown generally along the margins of shallow valleys.

Cultivation practices.—The arecanut is grown in this taluk as pure crop. These gardens are raised only where irrigation facilities are available.

Preparatory cultivation.—The land selected for the plantation is first of all ploughed once by heavy type of Kirloskar Plough or completely dug up by *guddali*, specially designed for this purpose and also to remove *hariyali* or *arike* grass (*Cynodon dactylon*). There is no terracing or levelling done since the topography of the soil is not so undulated. After uprooting *hariyali* grass completely pits will be dug, with a dimension of one foot square and 1½′ in

A FIELD THAT HAS BEEN WEEDED AND A FIELD THAT HAS HAD RAINS LOOK FINE.

depth at equal distances of about 8 feet from one pit to another. There is a practice to grow plantain crop in the beginning just to protect the young seedlings of the arecanut from severe heat of the sun. Therefore plantain suckers are planted in the above pits. When this crop has grown sufficiently to give shade *i.e.*, after one year of planting, arecanut seelings are planted in the pits by the side of plantain crop.

Seedling.—The arecanut seeds are selected from the mature and good bearing trees which are free from diseases for raising nursery. According to the local practice the selected seed nuts are sown during the month of February about half a foot in distance in the nursery bed prepared under shade and the plot is well manured. The seed will take 2-3 months to germinate. According to conditions irrigation is given to the seedlings till they are up-rooted for transplanting.

Usually 2-3 years old seedlings are preferred for transplantation which will be taken up during the months of July and August (*Aridra bede*), *i.e.* July is the proper time for this. 400 to 500 seedlings are planted in one acre.

Inter-cultivation.—After transplanting the areca seedlings the pits will be covered by applying 1-2 basketful of well rotted farm yard manure to each pit. No further operation will be taken till the plantain crop is up-rooted completely except irrigating the field according to the seasonal, conditions. When the areca seedlings are well established which will be about 4 to 5 years time after transplantation, the entire plantain crop will be removed. Then the field will be ploughed or dug up by *guddali* and small plots are made by forming ridges and irrigation channels This is locally called as forming '*madi*'. 6 to 8 areca trees will be in each '*madi*'. There is no elaborate arrangement for drainage as in *malnad* gardens in this part. A small trench will be provided around the few gardens which are very close to the tank. No systematic irrigation practice is observed. The whole garden is flooded once in a month during summer according to the condition.

The areca trees will begin to bear inflorescence, (this is locally called as *Hombale*) at the age of 7 to 8 years and come to full bearing only after the age of 10 years. Weeding operation will be attended regularly 2-3 times in a year.

Manuring.—15 to 20 cartloads of well rotted manure mixed with about 20 cartloads of transported soil will be applied per acre of garden once in 2 or 3 years. Groundnut oil cake powder at 40 maunds per acre is applied by a few gardeners. Due to the efforts of the agricultural departmental staff some gardeners are growing sunnhemp crop in the areca garden for green manuring purpose and now the area is increasing briskly after knowing the advantage of growing sunnhemp practically. Seed rate of sunnhemp per acre is about 25 to 30 seers.

Harvesting.—The custom of harvesting in this part is to cut the entire bunches after conducting rough test to examine the ripeness of the nut. The tool used for cutting the bunch is locally called as '*Joti*' which is a long, hard bamboo straight stick having a small sharp sickle tied at the top. All the bunches will not be ready for harvest at a time in each areca palm. Hence harvesting is done 3 to 4 times as and when the bunches are ready. Harvesting commences from the month of July to end of December. After the harvest, the nuts are collected and carted to the gardener's house for curing.

Curing the nuts.—There is no market for raw nuts in this part. Hence only cured nuts are supplied to the market for sale for chewing purpose.

ter separating the nuts from the stalk, husking, *i.e.*, removal of the outer in is done by skilled women labourers. They use for this purpose a cally made implement called '*Eligemane*' which consists of sharp knife ade fixed to a wooden plank on which they sit while operating. This work done very quickly and mechanically by trained women.

Slicing.—The nuts are usually sliced into four, for which the kernel is cut o two halves first, and each half will be cut further into two pieces along e length to prepare "*Holu adike*" which is in practice in this area. Husking d slicing involves labourious works which will be done on contract basis kind of nuts by a gang of women. It is a very pleseant sight to see the omen doing this work by singing songs or narrating some grand mother ories while they are engaged in that tedious work.

Boiling and Drying.—The entire sliced kernels are put to a big earthen or pper pot and water poured and some quantity of "*Ghogaru*" into it. Boiling done on an ordinary open fire specially prepared ovens near the gardener's use. The exact stage at which the boiling is stopped will be tested, e boiling kernels removed by means of perforated ladles and ansferred to a drying place where date palm mats are spread for this purpose. ccording to the temperature, 4-6 days drying is given to the boiled nuts nich are spread very thinly on the mats. No grading is usually done this tract by the gardeners.

Yield.—The yield of areca depends upon the rainfall and the systematic aintenance of gardens. From 50 to 60 maunds per acre is reported to be ghest yield. (Maund of 25 lbs.) 30 Maunds is taken as average yield if nfall conditions are favourble in the gardens round about Bheemasamudra d Bharamasagara.

Pest and diseases.—No serious pest and diseases are noticed in this tract r arecanut and also there is no fear from wild animals as in *Malnad* parts.

A disease (*Ganoderma lucidum*) locally called 'Anabe' roga is noticed cently here and there and severe in some gardens at Bheemasamudra. It fects the interior of the stems gradually causing of its death. The loss very much since it kills full bearings. It attacks the cocoanut palms also. ne Department of Agriculture has take keen interest and has evolved medial measures to control this disease and has educated the gardeners provide systematic drainage and to avoid overflooding the gardens. pplication of sulphur dust at one lb. per palm to the soil around the areca lm is advised and also demonstrated, to grow sunnhemp in the gardens to ercome the manurial problem since farm yard manure is not available plenty even at a higher rate. Pamphlets have been distributed to the rdeners printed in Kannada about details of *anabe roga* and its control easures. About 2 tons of sulphur dust were distributed among the gardeners 50% concession rates during this year.

The Plant Pathologist has conducted experiments recently using some s and tree killers in this area to enable the gardeners to uproot the affected lms easily.

Areca cultivation in this taluk is really a profitable one since they get t profit of nearly one thousand rupees per acre from areca only d about 200 rupees as an additional income from border crops like coanut, jack and citrus every year. Bheemasamudra lime is noted in this

area and is exported also some extent to Bombay and other States. The cost of cultivation of one acre of areca garden including the border crops is given below.

Cost of cultivation of an acre of arecanut garden in Chituldrug Taluk (Bheemasamudra area)

			Rs.	A.	P.
I.	Cost of permanent improvement :—				
	(*a*) Clearing and levelling	...	50	0	0
	(*b*) Fencing (including cost of materials and labour)		30	0	0
II.	*Preparatory cultivation*				
	(*a*) Excavating pits for planting	...	20	0	0
	(*b*) Cost of labour for planting	...	10	0	0
III.	Cost of seedlings	...	120	0	0
IV.	Manure				
	Cost of manure including transporting and applying	...	80	0	0
V.	Cost of irrigation by tank	...	10	0	0
VI.	Harvesting of bunches (contract basis)	...	20	0	0
VII.	Preparation for the market (lumpsump)	...	180	0	0
VIII.	Land cess	...	8	0	0
IX.	Watch and ward	...	12	0	0
	Unforeseen	...	10	0	0
			550	0	0

Income

		Rs.	
(i)	30 Maunds nuts (cured) at Rs. 35 works out	... 1,050	(Prevailing market rate
(ii)	From subsidiary crops	... 500	
	Total	... 1,550	
		550	
	Net income per acre after deducting cost of cultivation	... 1,000	

(Since this is a perennial crop, they are not spending towards cost o seedlings and excavation of pits every year. Instead of th they are spending now for plant protection work and applying o cake, etc.)

IMPROVEMENT OF COTTON BY COMMUNITY PRODUCTION

By G. Srinivasa Iyengar

To be worthy of a name, a cotton variety should be of a distinct type, *i*. have some definite characters which mark it as being different from all oth varieties. At present, in Mysore, there are some commercial varieties whi are mixtures and do not warrant any distinct variety. How two preserve a utilise superior varieties of cotton is a problem worthy of study, no less tha

methods of developing varieties by selection and breeding Cotton, ures in our industrial civilisation more largely than other plant products d the need of uniformity is greater with this than with any other crop. The st step taken up in Mysore in this regard is the establiehment of cotton rketing Co-operative Societies and regulated markets where it has been sible to get a proportionate value for the quality cotton that the members this community grow.

The need for improving the crop is being recognised in all the principal ions of cotton production. Superior strains have been evolved and the thods of breeding have been improved but have not been properly utilized the grower. In spite of the value of superior varieties being recognised, need for special precautions for large scale production of superior varieties s received very little attention. The mixing of superior varieties with erior ones has been tested on enormous scale everywhere and leaves no ıbt of its adverse effects. No complete utilization of superior varieties m possible under the present system of planting of different varieties.

Most of the commercial seed is raised by farmers without special isolation the varieties in large scale planting and without precautions of separate ning. Dealers have no agency to get large quantities of pure seeds, unless y deal with one community growing a single superior variety or go into ge scale cotton farming, in addition to their conducting business as seed rchants or have effective methods for keeping seeds pure. To grow a single erior variety of cotton, the scale of farming must be large enough to pro- e isolation or in other words to form a separate cotton community for pro- cing pure seeds. As large areas are not available in compact blocks one more villages may be selected for community growing, as a first step in intaining purity of the superior variety.

Co-operation with organised communities to establish new centres of seed pply is the only practical way of extending and establishing the utilizatton superior varieties. Keeping small quantity of seed separate, in a commu- y, growing mixed varieties is more expensive and dangerous. To keep ds pure under these conditions there is a constant danger of mixing as well difficult undertaking.

The public ginning system, which gives each farmer an admixture of neighbour's seeds is partly responsible for the contamination of the seed ck. In spite of breeding better varieties and efforts to increase the seed plies, the good stock still represents only an infinitesimal part of the ume of production. Thousands of bales of inferior cotton are produced ry year from seed that should have gone either to the oil miils or used as le feed instead of being planted. When an account is taken of the effects mixing and crossing of different varieties and the use of ordinary " gin- " seed for planting, it is no wonder that a pure variety gets deteriorated n during a short period of its introduction.

The need of varieties adopted to local conditions, as well as the need of erent kinds of fibres in Textile Industry is to be recognised, but there are reasons to justify the existence of a large number of varieties. Some eties like the Egyptians require rather special conditions but others like sore-American V and Sel. 69 can be grown on large regions. M. A. V. a y early maturing variety has been introduced successfully in widely differ- regions on a commercial scale. The wide range of adaptation is also ortant showing that production may be standardized. In view of the

availability of better varieties no reasons can be put further for continuing t produce on red soil in Mysore, cotton of less than one inch staple.

To give production, the best footing a different policy needs to b established in relation to cotton varieties. Any variety that is to be use properly and effectively must be kept by itself, since it is not possible to hav high quality production if several varieties are grown together in the sam area or community. Too frequent a change in the variety is also inconsisten with the interest of the producers. As far as possible the practical interest o each community should remain focussed on a single variety and changes mad only when definite advantages have been shown and seed supplies are avail able, so that all the neighbouring farmers may change together to the ne variety. The practice of introducing many new kinds or of renowing o varieties to meet commercial demands are based on misunderstanding of fac and do not tend to improve production.

With one variety properly isolated and selected under local conditions, th seed can not only be kept pure and uniform but it is also likely to give bett results than any seed that can be obtained from other areas. The degeneratio that results from the crossing of different varieties no doubt is the basis of th popular idea that superior cotton varieties soon run out and that fresh see must be brought from other places. Though selection must be maintained preserve a high degree of uniformity in any stock, deterioratiou is much mo rapid if superior varieties are planted side by side with inferior ones whic result in natural crossing. The progenies of hybrid plants show larg number of inferior plants showing conspicuous evidence of degeneratio The rapidity with which the varieties run out is dependent on the extent crossing that takes place.

Instances where some of the best and most popular varieties have bee grown for years in the same place should be sufficient to discredit the id that degeneration of varieties is inevitable or are to be expected in a few year Yet the idea of changing the seed is widely current in the cotton indust and continue to be developed by owners of gins who often sell cartloads fresh seeds to the farmers on a credit basis regardless of the fact that sellin mixed seed to the community only widens the range of mixing both in th gins and in the field. The only prospect of having a good variety is l united community action for cleaning out the mixed seed and then maintainin a pure stock. As long as isolation is maintained in the field the varieties a preserved with no evidence of running out, as the chances of cross pollinati that takes place in the field where mixed seed is sown is prevented.

After long period of years, it may be that the varieties becom standardised to the locality or become more susceptible to pests and diseas But at least in has to be recognised that such eventual standardizati would be quite distinct from the running out through crossing betwe different types that are grown and and mixed together.

The supposed remedy " changing the seed " does not remove the cause degeneration but only invites more running out. Instead of change of se the methods of obtaining the seed supply need to be changed, so that t varieties can be preserved and kept uniform instead of being mixed a allowed to deteriorate. No matter how good the original varieties may ha been, a mixed stock becomes in a few generations thoroughly miscellaneo with many abnormal and infertile plants, very inferior to the parental ty

Established community production of the best variety that can be grown
ler the local conditions is the ideal that should not be sacrificed, to curio-
or casual interest in untried novelties even though widely advertised.
sting of new varieties is important of course, so that no really valuable
provement may be lost sight of but not many farmers can observe the pre-
itions that are necessary to secure definite determinations of the relative
ues of the varieties. Even in the research stations, it is a difficult problem
uiring several years to get reliable data.

To begin a new community, the best seed obtained from the breeding
ion, where isolation and selection have been in progress, to guard the
ity and uniformity of the stock should be used with the same precautions
tinued for a few years under the local conditions, the home grown seed is
ly to be found distinctly better than any that can be had. A special value
dicated for selection under local conditions, in giving a better adjustment
more uniform expression of the desirable characters of a variety in
trast with the greater variability that often is shown in varieties that are
ted for the first time under new environmental conditions.

In organised communities the farmers who raise better cotton than their
hbours usually are forced to sell at the same price to the local buyers.
nufacturers pay a high price for quality cotton but the difference goes to
buyer instead of being shared by the growers. As such the only object of
farmer in choosing varieties is to grow any variety in large quantity
ply because the commercial system fails to apply adequate discrimination
quality cotton in buying from the farmers. Failure to give proper
ouragement to the farmer, in his efforts to improve the crop is a serious
ct, but organised communities can overcome this by pooling their quality
duct and get a proportionate value.

Organised growers of one pure variety are progressive in many ways than
unorganised ones. When a single variety is grown, interest and
ity to handle the crop in a skilful manner develops in the farmers and
r results will be better than their neighbours. They gain a thorough
iliarity with the characteristics and behaviour of the single high
lity type they grow. With such a definite understanding of the
aviour of one variety, the farmers adjust their methods of cultivation to
difference of the soil, season and time of planting and also to take up
ely remedial measures to combat pests and diseases. The products of organis-
communities are more uniform not only because pure varieties are grown
also the treatment to the crop is better. The cotton produced is more
uable on account of its uniform character which is well appreciated by
Spinning industry. Thus the cotton offered by the farmers growing a
erior variety could be definitely standardised and its value more definitely
wn to the farmer as well as to the buyers and manufacturers.

The manufacturers are not in a position to buy directly from the farmers
see that full prices are paid to such farmers who offer good quality cotton.
ey depend entirely on the buyers who by assembling and sorting make up
mmercial lots. Even this could be avoided if the crop could be standardised
oduction by one community organization. This in turn, involves the
nting of the uniform variety of seed and give the best attention which
uld result in normal development and maturity. Pure seeds are essential
a uniform product but favourable conditions of growth are necessary in
er to obtain a regular normal development.

THERE IS NO NEED TO LOOK AT A FIELD TO WHICH SILT HAS BEEN CARTED.

For the spinning industry the particular requirement is that the farmer product should be uniform even though it be of a shorter staple. Mixtures varying length of staple are useless and even such bad quality fibres are so to buyers who cannot detect even badly mixed fibres. The most defin method of detecting mixtures is to inspect the plants in the fields. This easy for those who are familiar with the variety, to see whether the plants a all of one kind or are made up of different mixtures of all kinds. In the lo staple market a low percentage of mixture of short staple cotton is overlooke But unscrupulous farmers make it a practice of adulterating a high percenta of short staple cotton with a long staple.

At present the entire responsibility of selecting and standardizing t product offered for sale by the farmer is thrown on the buyers or upon t commercial system. Where a uniform seed stock is planted the quality of t fibre is only affected by conditions of production and as such the qual can be standardized. Different grades of cotton can come from the sa field but not different classes of cotton. The grade depends upon conditio of cotton as determined by the weather or care used in picking and ginni whereas class takes account of the quality and uniformity of the fibre.

No cotton can attain its true industrial value without regularity of sup of lint and the development of confidence by the industrial world that the r material will be available from year to year. Stabilising production possible only through community organization which would be an advanta to the industry. The underlying principle of such an organization impl the use of pure seed, care in picking, storing and ginning.

Progress in cotton communities is not be expected from exter influences or from organizations alone but depends on local interest inspi by practical understanding and a right public spirit. Organisations differ measures of progress have to be adopted to the local needs and develo mainly through local interest and initiative. Methods of organizing cot growing communities need to be devised, studied and gradually perfect like, methods of organizing industrial co-operations or others spe forms of co-operation.

Cotton breeders should know the value and need of the commun co-operative growers as well as the cotton industry and thus contribute the National Wealth.

The author is Senior Asst. Botanist (Cotton), Mysore Departmen Agriculture.

THERE CAN BE NO VIGOUR IN THE NATION WHERE THERE IS NO VITALITY IN THE LAND—*Prof. Kay.*

WORK DOES MORE THAN GETS OUR LIVING; IT GETS US OUR LIFE—*Henry Ford.*

HAPPINESS IS SIMPLY WORK'S GREATEST BY-PRODUCT—*Conrad Adena*

VOLUME, WEIGHT AND OTHER DATA RELATING TO THE PRINCIPAL CROPS OF MYSORE[1]

By M. L. N. Iyengar

Technical Asst. to Director of Agriculture

Paddy Varieties

Variety	*Weight of 1 Seer*		*Mysore palla*
	lb.	*oz.*	*lb.*
S. 139 Kaddi ...	1	12.50	178
S. 199 Alur Sanna ...	1	11.25	170
S. 246 Nagpur Sanna ...	1	9.00	156
S. 317 Halubbalu ...	1	13.50	184
S. 624 Maharajabogha ...	1	10.50	166
S. 661 Coimbatore Sanna ...	1	12.40	178
S. 684 „ ...	1	14.00	188
S. 699 „ ...	1	11.75	173
S. 701 „ ...	1	12.25	177
S. 705 Bangarkaddi ...	1	11 60	173
S. 718 Ratnachudi ...	1	11.50	172
S. 749 „ ...	1	12.40	178
S. 1092 Bangarkovi ...	1	12.40	178
H. 294 Doddabyra ...	1	13.25	183
H. 320 Hunisehoovina bhatta ...	1	12.75	180
H. 497 Bangaratheege ...	1	9.25	158
H. 1043 Kapile Sanna ...	1	12.00	175
B. 16 Thogarina ...	1	14.25	189
B. 194 Musalli ...	1	13.50	184
B. 281 Bilikannu Hegge ...	1	14 00	187
B. 1399 Puttabhatta ...	1	14,00	187
Ch. 45 China paddy ...	1	14.25	189
Baroda paddy ...	1	13.20	183
Ragi (*Eleusine coracana*) **Varieties**			
Ragi 1 K. 1 ...	2	3.5	222
„ 3 R. 0009 ...	2	2.7	216
„ 4 R. 0862 ...	2	4.4	228
„ 6 R. 0870 ...	2	4.7	230
„ 8 R. 0833 ...	2	6.0	238
„ 9 R, 0324 ...	2	5.7	236
„ 22 H. 22 ...	2	4.0	225
Majjige Ragi ...	2	5.0	231
E. S. 11 Ragi ...	2	4.3	227
Jola : Jowar (*Sorghum vulgare*) **Varieties.**			
Local ...	2	3.5	222
Jabalpuri ...	2	5.0	231
S. 2—2 ...	2	4.0	225
Maldandi ...	2	5.0	231
Hyderabad Bile jola ...	2	5.0	231
Early Kalo (American) ...	2	4.2	227
Mungari yellow ..	2	2 0	213
Vogaru jola ...	2	3.0	219
Kaki jola ...	1	15.5	197

1. Compiled from data furnished by Agricultural Farms and Economic Botany Section to whom I am grateful.

Kannada and Common name	Scientific name	Weight of 1 Mysore seer lbs.	oz.	palla lbs.
Minor Millets.				
Same :	*Panicum miliare* Lamk	2	3.4	221
Hejjave. Same 3 :	*Panicum miliare* Lamk	2	3 5	222
Baragu Panic Millet French Millet	*Panicum miliaceum* L	2	5 .0	231
Haraka, Ditch Millet	*Paspalum orbiculare* Forst f Syn. *P. scrobiculatum*	1	12.6	179
Sajje. Pearl Millet. Bulrush millet,	*Pennisetum typhoideum* L. Rich	2	0.0	200
Navane. Italian millet	*Setaria italica* (L) Beauv	2	1.7	211
Oodalu. Japanese millet	*Echinochloa crusgalli* var *frumantacea* (Roxb) Wight	1	12.0	175
Pulses.				
Thogari. Pigeonpea ; redgram,	*Cajanus cajan* (L) Millsp	2	5 5	234
Hurali. Horsegram	*Dolichos biflorus* L	2	8.6	254
Avare	*Dolichos lablab*	2	5.9	237
Hesaru, Green gram	*Phaseolus radiatus*	2	4.4	228
Uddu Black gram	*Phaseolus mungo*	2	7.2	245
Kadale. Bengal gram ; chickpea Local	*Cicer arietinum* L	2	4.3	227
Chamarajnagar		2	5.0	231
Nagamangala		2	5.5	234
Thadagani or *Alasande* Cowpea,	*Vigna sinensis* (L) Endl Syn. *V. Catjang* Walp	2	8.0	250
Soyabean	*Glycine max*	2	2.6	238
Oil Seeds				
Haralu. Castor Local,	*Ricinus communis* L	1	8.9	172
Rosy		1	13.0	181
L. 53		1	11.0	169
L. 73		1	13.0	181
L. 280		1	6.0	187
Hyderabad		1	10.2	164
Nelagadale Groundnut	*Arachis hypogaea* L			
Pods,		...	15.8	98.75
Kernels		1	14.5	191.00
H. G. 1 Pods		...	14.4	90.00
Spanish Pods		1	...	100.00
Valencia		1	12.0	75.00
Yellu. Gingelly Til,	*Sesamum indicum* L	2	1	206.00
Hutchellu. Niger	*Guizotia abssyinica* (L. f) Cass	1	12.2	176.00
Kusume. Safflower	*Carthamus tinctorius* L	1	11,5	172.00
Agase. Linseed	*Linum usitatissimum* L	2	0.0	200.00
Other Seeds				
Dhaniya. Coriander	*Coriandrum sativum*	1	...	100
Happsenabu, Sannhemp	*Crotalaria juncea*	2	4.6	228
Suryakanthi, Sunflower,	*Helianthus anuus*	1	6.3	139

Percentage of oil in some Oil Seeds

Gingelly	48%	Groundnut H.G. 1	48%
Niger	45%	Spanish	49%
Safflower	25%	A. H. 25	49%
Castor Local	51.35%	H. G. 3	48%
„ M.C 1. (L. 53)	49.35%	H. G. 4 (G. 0343)	48%
„ „ 4. (L. 73)	51.14%	H. G. 7 (G. 0538)	50%
„ „ 7. (L. 280)	50.30%	H. G. 8 (G. 0416)	50%
„ Rosy	51. 5%	H. G. 9 (G. 0553)	49%
		H. G. 10 (G. 0577)	49%

Shelling Percentage of some Groundnut Varieties

Groundnut H. G. 1	73%	Groundnut H. G. 9	78%
H. G. 4	66%	H. G. 10	74%
H. G. 7	79%	Spanish	76%
H. G. 8	79%	A.H. 25	72%

Milling Percentage of Paddy Varieties

			Percentage by Volume	Weight
1	S. 139 Kaddi	...	49	68
2	S. 199 Alur Sanna	...	50	69
3	S. 246 Nagpuri Sanna	...	46	68
4	S 317 Halubbalu	...	52	74
5	S. 624 Maharajaboga	...	49	68
6	S. 661 Coimbatore Sanna	...	52	72
7	S. 684 Do	...	52	75
8	S. 699 Do	...	51	71
9	S. 701 Do	...	52	74
10	S. 718 Rathnachudi	...	52	72
11	S. 749 Do	...	52	75
12	S. 1092 Bangarkovi	...	52	74
13	H. 294 Doddabyra	...	50	69
14	H. 320 Hunisehoovina bhatta	...	50	69
15	H. 497 Bangaratheege	...	48	68
16	B. 16 Thogarina	...	52	70
17	B. 194 Mussalli	...	51	69½
18	B. 285 Bilikannuhegge	...	50	67

Data relating to some Cotton Varieties

Strain		Ginning %	Staple length (in inches)
S. 69 Medium staple	...	29	7/8
Jayawanth	...	28	7/8
Jayadhar	...	30	15/16
M. A. V	...	35	1 1/16—1 1/8

Driage of some Crops

100 lbs. of fresh groundnut pods yield 65 lbs. of dry pods.
Do tobacco leaves yield 15.5 lbs. of cured leaves.
Do chillies yield 31.01 lbs. of dry cherries.
Do arecanut on boiling yield 30.4 lbs. cured nuts.
Do cardamom (Saklespur) yield 21.4 lbs. of dried capsules.
Do cardamom (Karkodi) yield 19.6 lbs. ,,
Do coffee (Cherry) yield 34.92 lbs.
Do coffee (Parchment) 52.5 lbs.
Do paddy (Coimbatore sanna) 94.2 lbs.
100 seers of fresh paddy (Coimbatore sanna) 94.0 lbs.

Data relating to Sugarcane

Variety	Yield per acre of		Quality of juice			
	Cane Ton	Jaggery Maunds	Extraction Per cent	Brix Per cent	Sucrose Per cent	Purity Per cent
1. Pattapatti Local striped ...	15-20	180-320	62-64	20-22	18-19	90-93
2. Cheni ...	15-20	150-180	55-56	19-20	17-18	88-90
3. H. M. 320 ...	30-35	330-390	60-63	20-22	18½-19½	90-93
4. H. M. 645 ...	30-35	280-320	55-56	20-22	18-19½	90-93
5. H. M. 661 ...	40-45	400-450	56-58	20-22	18-19½	90-93
6. I. C. 26 ...	40-45	400-450	60-62	19-20	17-18	89-92
7. I. C. 215 ...	40-45	440-500	60-62	19-20	17-18	89-92
8. Co. 290 ...	25-30	250-300	55-58	17-19	15-16½	87-89
9. Co. 419 ...	35-40	350-400	56-58	20-21	18-19	90-93

H. M. 661—for Bangalore and Mysore Districts. Ratoons well grows even under adverse soil conditions.

H. M. 645—Thin, Cheni type in place of cheni.

I. C. 215—Promising introduction in *Malnad*.

CALENDAR FOR 1954

RAHUKALA AND GULIKAKALA

Rahukala	Days of week	Gulikakala
30 to 6 P.M.	Sunday	3 to 4-30 P.M.
-30 to 9 A.M.	Monday	1-30 to 3 P.M.
to 4-30 P.M.	Tuesday	12 NOON to 1-30 P.M.
2 NOON to 1-30 P.M.	Wednesday	10-30 A.M. to 12 NOON
30 to 3 P.M.	Thursday	9 to 10-30 A.M.
0-30 A.M. to 12 NOON	Friday	7-30 to 9 A.M.
to 10-30 A.M.	Saturday	6 to 7-30 A.M.

Holidays	English Dates	Days of the week	Dates: Chandra-mana	Dates: Sowra-mana	Thithies in Ghaliges and Vighaliges	Nakshatras in Ghaliges and Vighaliges
						MARGASI
G	1	Friday ...	12	17	Dwadasi ... 59 49	Vishakha ... 18
	2	Saturday ...	13	18	Trayodasi ... 60 0	Anuradha ... 23
	3	Sunday ...	13	19	Trayodasi ... 1 38	Jyesta .. 26
	4	Monday ...	14	20	● Chaturdasi 2 39	Moola ... 28
	5	Tuesday ...	30	21	● Amavasya 2 23	Poorvashada... 29
						PUSH
	6	Wednesday	1-2	22	Padyami ... 0 52 Bidige ... 57 58	Uttarashada ... 28
	7	Thursday...	3	23	Tadige ... 54 59	Sravana ... 26
	8	Friday ...	4	24	Chouthi ... 50 30	Dhanishta ... 24
	9	Saturday ...	5	25	Panchami ... 45 12	Satabhisha ... 21
	10	Sunday ...	6	26	Shashti ... 39 33	Poorvabhadra 17
	11	Monday ...	7	27	Sapthami ... 33 42	Uttarabhadra 13
	12	Tuesday ...	8	28	Ashtami ... 27 41	Revati ... 9
	13	Wednesday	9	29	Navami ... 21 56	Asvini ... 27
				Mak	ara	
G	14	Thursday...	10	1	Dasami ... 16 33	Bharani ... 1 Krithika ... 56
	15	Friday ...	11	2	Ekadasi ... 11 42	Rohini ... 54
	16	Saturday ...	12	3	Dwadasi ... 7 36	Mrigasira ... 53
	17	Sunday ...	13	4	Trayodasi ... 4 23	Aridra ... 52
	18	Monday ...	14	5	Chaturdasi ... 2 14	Punarvasu ... 52
	19	Tuesday ...	15	6	O Poornima... 1 15	Pushya ... 54
						PUS
	20	Wednesday	1	7	Padyami ... 1 34	Aslesha ... 56
	21	Thursday...	2	8	Bidige ... 3 8	Makha ... 60
	22	Friday ...	3	9	Tadige ... 5 59	Makha ... 1
	23	Saturday ...	4	10	Chouthi ... 9 57	Pubba ... 6
	24	Sunday ...	5	11	Panchami ... 14 44	Uttara ... 12
	25	Monday ...	6	12	Shasti ... 20 5	Hasta ... 18
G	26	Tuesday ...	7	13	Sapthami ... 25 35	Chitta ... 25
	27	Wednesday	8	14	Ashtami ... 30 42	Swathi ... 31
	28	Thursday...	9	15	Navami ... 35 9	Vishakha ... 37
	29	Friday ...	10	16	Dasami ... 38 37	Anuradha ... 42
	30	Saturday ...	11	17	Ekadasi ... 40 50	Jyeshta ... 45
	31	Sunday ...	12	18	Dwadasi ... 41 46	Moola ... 47

Yogams	Feasts, Festivals, Government Holidays and Rainfall according to Nakshatras	Dates of Cattle Fairs, Cattle Shows, Agricultural Exhibitions and other useful notes
IULA		Sunrise 6-44 A.M.
iti ...	New Year's Day, Vakye Ekadasi.	Cattle show at Hassan Town
ola ...		
da-Vriddhi ..	Masa sivarathri, Thondara	dippodi Alwar Thrunakshatram
uva ...	Amavasya for all. Poorvas	hadha rain, 3rd pada, Com-
	mencement of Kotara	Utsava
ghatha ...		
DHA		
sha ...	Moon rise, North horn	
a ...	Purvashadha rain, 4th pada	Margasira Lakshmivratham
hi ...	Durvaganapathi Varatham	
ipatha ...		
yan ...	Utharashadha rain, 1st pada, Thulushasti, Ghati Subramanyaswami Car festival, Cattle show	
gha ...	Kudarij Vettam	
...		
ha-Sadya ...	Bhogi feast, Makara Sankranthi	
ia ...	Uttarayana Punyakala, Halaganamudi Venkataramanaswami Car festivel, Pongal feast.	
a ...	Ekadasi for all	
ma ...	Uttarashdha rain, 3rd pada, Chunchanakatte Rama-	
a ...	[swami Car festival, Cattle fair	
hriti ...	Banashankari vratha, Melukote Punarvasu Utsava	
kamba ...	Eclipse of the Moon, Ranganathaswami Car festival, Srirangapatna.	
ULA		
ti ...	Uttarashadha rain, 4th pada, Sivasamudra Ranganatha-	
hman ...	Car festival at Mugur, Cattle fairs. [swami Car festival.	
bhagya ...	Kurathalwar Thirunakshatram.	
hana ...	Birthday of Swami	
anda ...	Vevekananda	(1) Chunchanakatte Yadathore Tk.
rma ...		(2) Sivgand, Nelamangala Tk.
ti ...	Republic Day, Trisrostaka,	(3) Nagamudeke, Pavgada Tk.
la ...	Sravana rain, 2nd pada	(4) Hemavathi, Krishnarajapet Tk.
la ...		(5) Kemmanahalli, Koratagere Sub-Tk.
dhi ...		(6) Vokkaleri, Kolar Tk.
va ...	Ekadasi for all.	(7) Chennagiri Town.
hata ...		(8) Harihar Town.
		(9) Hemmigepura, Anekal Tk.

Holidays	English Dates	Days of the week	Dates: Chandra-mana	Dates: Sowra-mana	Thithies in Ghaliges and Vighaliges	Nakshatras in Ghaliges and Vighaliges
						PUSHI
	1	Monday ...	13	19	Trayodasi ... 41 22	Poorvashadha 48
	2	Tuesday ...	14	20	Chaturdasi ... 39 41	Uttarashadha 48
	3	Wednesday	15	21	● Amavasya 36 53	Sravana ... 47
						MAGH
	4	Thursday...	1	22	Padyami ... 33 4	Dhanista ... 44
	5	Friday ...	2	23	Bidige ... 28 28	Sathabhisha ... 41
	6	Saturday ...	3	24	Tadige ... 23 16	Poorvabhadra 35
	7	Sunday ...	4	25	Chouthi ... 17 35	Uttarabhadra 33
	8	Monday ...	5	26	Panchami ... 11 41	Revathi ... 29
	9	Tuesday ...	6	27	Shasti ... 5 46	Aswini ... 25
	10	Wednesday	7-8	28	Saptami ... 0 7 Ashtami ... 54 25	Bharani ... 21
	11	Thursday...	9	29	Navami ... 49 34	Krithika ... 18
				Kumbha		
	12	Friday ...	10	1	Dasami ... 45 30	Rohini ... 15
	13	Saturday ...	11	2	Ekadasi ... 42 19	Mrigasira ... 13
	14	Sunday ...	12	3	Dwadasi ... 40 13	Aridra ... 12
	15	Monday ...	13	4	Trayodasi ... 39 17	Punarvasu ... 12
	16	Tuesday ..	14	5	Chaturdasi ... 39 40	Pushya ... 13
	17	Wednesday	15	6	○ Poornima 41 9	Aslesha ... 16
						MAG
	18	Thursday...	1	7	Padyami ... 44 11	Makha ... 20
	19	Friday ...	2	8	Bidige ... 48 10	Pubba ... 24
	20	Saturday ...	3	9	Tadige ... 53 2	Uttara ... 30
	21	Sunday ...	4	10	Chouthi ... 58 26	Hasta ... 37
	22	Monday ...	5	11	Panchami ... 60 0	Chitta ... 43
	23	Tuesday ...	5	12	Panchami ... 3 58	Swathi ... 50
	24	Wednesday	6	13	Shasti ... 8 58	Vishakha ... 55
	25	Thursday...	7	14	Saptami ... 13 14	Anuradha ... 60
	26	Friday ...	8	15	Ashtami ... 16 28	Anuradha ... 0
	27	Saturday ...	9	16	Navami ... 18 31	Jyesta ... 4
	28	Sunday ...	10	17	Dasami ... 19 17	Moola ... 6

Yogams	Feasts, Festivals, Government Holidays and Rainfall according to Nakshatras	Dates of Cattle Fairs, Cattle Shows, Agricultural Exhibitions and other useful notes
ULA		Sunrise 6-48 A.M.
sha ..	Soma Pradosha,	
a ...	Masa Sivarathri, Sravana	rain, 4th pada
hi-Vyathipatha ...	Sarvatra Tai Amavasya	Garuda jayanthi, Punya-divasa Purandaradasara
DHA		
yan ...		
gha ...	Moon rise, Jamadisani month	
...	Dhanista rain, 1st pada	
ıa ...	Chouthi & Panchami, both thithies	
ya ...		
a ...	Rathasaptami, Dhanista rain, 2nd pada	
a ...		
...		
rithi ...	Dhanista rain, 3rd pada, Kumbha Sankramana	
kamba ...	Bhishma Ekadasi	
thi ...		
hman ...	Thondainur Krishnaswami Car festival.	
hagya ...		
ana ...	Vyasa Poornima	
ULA		
nda ...	Sathabhisha rain, 1st pada	Mallikarjunaswami Car festival, Bettadapura
rma ...		
i ...		Narasimhaswami Car festival,
la ...	Sathabhisha rain, 2nd pada	Sebi, Cattle fairs
la ...		Srinivasaswami Car festival,
lhi ...		Karighatta
a ...		Mari-Saru Uthanahalli Jatre
atha ...	Sathabhisha rain, 3rd pada	Cattle fairs ,
ha ...		
...		
i ...	Sathabhisha rain, 4th pada	

Holidays	English Date	Days of the weeks	Dates: Chandra-mana	Dates: Sowra-mana	Thithies in Ghaliges and Vighaliges	Nakshatras in Ghaliges and Vighaliges
						MAG
	1	Monday ...	11	18	Ekadasi ... 18 13	Poorvashada 7
	2	Tuesday ...	12	19	Dwadasi ... 16 65	Uttarashada 7
G	3	Wednesday	13	20	Trayodasi ... 14 2	Sravana ... 6
	4	Thursday...	14	21	Chaturdasi ... 10 10	Dhanista ... 4
	5	Friday ...	30	22	● Amavasya 5 30	Satabhisha ... 1 Poorvabhadra 56
						PHALGU
	6	Saturday ...	1-2	23	Padyami ... 0 54 Bidige ... 54 32	Uttarabhadra 54
	7	Sunday ...	3	24	Tadige ... 48 40	Revathi ... 50
	8	Monday ...	4	25	Chouthi ... 42 37	Aswini ... 46
	9	Tuesday ...	5	26	Panchami ... 36 48	Bharani ... 42
	10	Wednesday	6	27	Shasti .. 31 22	Krithika ... 38
	11	Thursday...	7	28	Saptami ... 26 33	Rohini .. 35
	12	Friday ...	8	29	Ashtami ... 22 28	Mrigasira ... 33
	13	Saturday ...	9	30	Navami ... 19 19	Aridra ... 32
				Meena		
	14	Sunday ...	10	1	Dasami ... 17 14	Punarvasu ... 32
	15	Monday ...	11	2	Ekadasi ... 16 20	Pushya ... 33
	16	Tuesday ...	12	3	Dwadasi ... 16 41	Aslesha ... 35
	17	Wednesday	13	4	Trayodasi ... 18 20	Makha ... 38
H	18	Thursday...	14	5	Chaturdasi ... 21 11	Pubba ... 43
	19	Friday ...	15	6	○ Poornima... 25 8	Uttara ... 48
						PHALGU
	20	Saturday ...	1	7	Padyami ... 29 53	Hasta ... 55
	21	Sunday ...	2	8	Bidige ... 35 8	Chitta ... 60
	22	Monday ...	3	9	Tadige ... 40 31	Chitta ... 1
	23	Tuesday ...	4	10	Chouthi ... 45 35	Swathi ... 8
	24	Wednesday	5	11	Panchami ... 49 43	Vishakha ... 14
	25	Thursday...	6	12	Shashti ... 52 56	Anuradha ... 19
	26	Friday ...	7	13	Saptami ... 54 56	Jyesta ... 23
	27	Saturday ...	8	14	Ashtami ... 55 54	Moola ... 26
	28	Sunday ...	9	15	Navami ... 54 53	Poorvashadha 27
	29	Monday ...	10	16	Dasami ... 52 56	Uttarashadha 27
	30	Tuesday ...	11	17	Ekadasi ... 49 83	Sravana ... 27
	31	Wednesday	12	18	Dwadasi ... 45 51	Dhanista ... 25

Yogams		Feasts, Festivals, Government Holidays and Rainfall according to Nakshatras	Date of Cattle Fairs, Cattle Shows, Agricultural Exhibitions and other useful notes
ULA			Sunrise 6-39 A.M.
hipatha	...	Ekadasi for all	
van	...	Pradosha	
gha	...	Panditha Aradyajayanthi,	Mahasivarathri and Ash Wednesday
	...	Amavasya for all	
ya	...	Poorvashadha rain, 1st pada	
DHA			
ha	...		
a	...	Birthday of Sri Ramakrishna	
a	...	Poorvabhadra rain, 2nd pada	
a	...		
riti	...		
kamba-Preethi	...	Poorvabhadra rain, 3rd pada	
hman	...		
bhagya	...	Navami + Dasami Thithi	
bhana	...	Poorvabhadra rain, 4th pada	
anda	...		
rma	...	Pradosha	
ti	...		
la	...	Holi Feast	
da	...	Panguni Uttara	
ULA			
dhi	...	Uttarabhadra rain, 2nd pada.	Melkote Narayanaswamy Jayanthi
a	...	Mahabhisheka, Melukote	
atha	...	Vadirajaswamy Punyadina	
ha	...	Uttarabhadra rain, 3rd pa	
a	...		
i	...	Kandagala Car festival	
hipatha	...		
van	...	Uttarabhadra rain, 4th pada,	Kollur Mookamba Car festival
gha	...		
	...		
a	...	Ekadasi for all	
ya	...	Revathi rain, 1st pada	

Holidays	English Dates	Days of the week	Dates: Chandra-mana	Dates: Sowra-mana	Thithies in Ghaliges and Vighaliges	Nakshatras in Ghaliges and Vighaliges
						PHALGUI
	1	Thursday ..	13	19	Trayodasi ... 41 2	Sathabhisha ... 22
	2	Friday ...	14	20	Chaturdasi ... 35 35	Poorvabhadra 19
	3	Saturday ...	30	21	● Amavasya 29 46	Uttarabhadra 15
						JAYA CHAIT
	4	Sunday ...	1	22	Padyami ... 23 43	Revati ... 1
	5	Monday ...	2	23	Bidige ... 19 20	Asvini ... 8
	6	Tuesday ...	3	24	Tadige ... 13 5	Bharani ... 3 Krithika ... 56
	7	Wednesday	4	25	Chouthi ... 6 36	Rohini ... 55
	8	Thursday ...	5-6	26	Panchami ... 1 12 Shasti ... 57 3	Mrigasira ... 54
	9	Friday ...	7	27	Saptami ... 54 2	Aridra ... 52
	10	Saturday ...	8	28	Ashtami ... 51 39	Punarvasu ... 52
	11	Sunday ...	9	29	Navami ... 51 37	Pushya ... 52
	12	Monday ...	10	30	Dasami ... 51 36	Aslesha ... 55
				Mesha		
H	13	Tuesday ...	11	1	Ekadasi ... 53 25	Makha ... 58
	14	Wednesday	12	2	Dwadasi ... 58 48	Pubba ... 60
	15	Thursday...	13	3	Trayodasi ... 60 0	Pubba ... 2
	16	Friday ...	13	4	Trayodasi ... 4 36	Uttara ... 3
	17	Saturday ...	14	5	Chaturdasi ... 6 3	Hastha ... 14
	18	Sunday ...	15	6	○ Poornima 10 15	Chitta ... 21
						CHAIT
	19	Monday ...	1	7	Padyami ... 15 38	Swathi ... 27
	20	Tuesday ...	2	8	Bidige ... 20 25	Vishakha ... 33
	21	Wednesday	3	9	Tadige ... 24 25	Anuradha ... 38
	22	Thursday...	4	10	Chouthi ... 26 26	Jyesta ... 42
	23	Friday ..	5	11	Panchami ... 28 13	Moola ... 45
	24	Saturday ...	6	12	Shasti ... 28 5	Poorvashada 47
	25	Sunday ...	7	13	Saptami ... 27 29	Uttarashada 48
	26	Monday ...	8	14	Astami ... 25 49	Sravana ... 46
	27	Tuesday ...	9	15	Navami ... 22 17	Dhanista ... 45
	28	Wednesday	10	16	Dasami ... 18 20	Sathabhisha ... 42
	29	Thursday...	11	17	Ekadasi ... 13 23	Poorvabhadra 39
	30	Friday ...	12	18	Dwadasi ... 8 0	Uttarabhadra 36

Yogams	Feasts, Festivals, Government Holidays and Rainfall according to Nakshatras	Dates of Cattle Fairs, Cattle Shows, Agricultural Exhibitions and other useful notes
LA		Sunrise 6-20 A.M.
...	Pradosha	
...	Masa Sivarathri, Bodayana Amavasya	
na, Indra ...	Amavasya for all	
HA		
thi ...	Lunar New Year's Day	
amba ...	Sri Krishnaswamy Car festival, Thulsithota, Banagalore	
...		
man ...	Revathi rain, 3rd pada	
iagya ...		
ana ...		
ida ...	Revathi rain, 4th pada	
ma ...	Sri Rama Navami	
...		
...	Asvini rain, 1st pada, Solar	
...	Tamil New Year's Day	
ia ...		
a ...	Good Friday	
atha ...	Asvini rain, 2nd pada	Shab-e-Barat
a ...	Karaga at Bangalore	,,
LA		
...		
...	Asvini rain, 3rd pada	
ipatha ...		
in ...		
ia ...	Asvini rain, 4th pada	
...		
...		
...		
...	Bharani rain, 1st pada	
...		
ia ...	Ekadasi for all	
Vaidhriti ...		

Holidays	English Dates	Days of the week	Dates: Chandra-mana	Dates: Sowra-mana	Thithies in Ghaliges and Vighaliges	Nakshatras in Ghaliges and Vighaliges
						CHAI
	1	Saturday ...	13-14	19	Trayodasi ... 0 36 Chaturdasi ... 59 1	Revati ... 3
	2	Sunday ...	30	20	● Amavasya 49 50	Asvini ... 2
						VISHA
	3	Monday ...	1	21	Padyami ... 44 0	Bharani ... 2
	4	Tuesday ...	2	22	Bidige ... 38 31	Krithika ... 1
				Ram	zan	
	5	Wednesday	3	23	Tadige ... 33 10	Rohini ... 1
	6	Thursday...	4	24	Chouthi ... 29 0	Mrigasira ... 1
	7	Friday ...	5	25	Panchami ... 26 18	Aridra ... 1
	8	Saturday ...	6	26	Shashti ... 24 1	Punarvasu ... 1
	9	Sunday ...	7	27	Sapthami ... 23 36	Pushya ... 1
	10	Monday ...	8	28	Ashtami ... 23 40	Aslesha ... 1
	11	Tuesday ...	9	29	Navami ... 24 12	Makha ... 1
	12	Wednesday	10	30	Dasami ... 27 39	Pubba ... 2
	13	Thursday...	11	31	Ekadasi ... 31 12	Uttara ... 2
				Vris	habha or Vaiyasi	
	14	Friday ...	12	1	Dwadasi ... 36 7	Hasta ... 3
	15	Saturday ...	13	2	Trayodasi ... 40 49	Chitta ... 3
	16	Sunday ...	14	3	Chaturdasi ... 45 38	Swathi ... 4
G	17	Monday ...	15	4	○ Poornima.. 50 26	Vishakha ... 5
						VAISHA
	18	Tuesday ...	1	5	Padyami ... 54 13	Anuradha ... 5
	19	Wednesday	2	6	Bidige ... 57 16	Jyesta ... 6
	20	Thursday...	3	7	Tadige ... 57 28	Jyesta ..
	21	Friday ...	4	8	Chouthi ... 59 24	Moola ...
	22	Saturday ...	5	9	Panchami ... 59 2	Poorvashada...
	23	Sunday ...	6	10	Shasti ... 57 58	Uttarashada ...
	24	Monday ...	7	11	Sapthami ... 52 50	Sravana ...
	25	Tuesday ...	8	12	Ashtami ... 48 1	Dhanishta ...
	26	Wednesday	9	13	Navami ... 43 1	Satabhisha ...
	27	Thursday...	10	14	Dasami ... 37 50	Poorvabhadra Uttarabhadra 5
	28	Friday ...	11	15	Ekadasi ... 31 49	Revati ... 5
	29	Saturday ...	12	16	Dwadasi ... 25 52	Asvini ... 4
	30	Sunday ...	13	17	Trayodasi ... 19 50	Bharani ... 4
	31	Monday ...	14	18	Chaturdasi ... 41 1	Krithika ... 4

Yogams	Feasts, Festivals, Government Holidays and Rainfall according to Nakshatras	Dates of Cattle Fairs, Cattle Shows, Agricultural Exhibitions and other useful notes
JLA		Sunrise 6-8 A.M.
kamba ...	Avamaha, Swethavaraha Jayanthi	
i ...	Amavasya for all.	
HA		
nman ...		
hagya-Shobhana	Bharani rain, 3rd pada	
nda ...	Basava Jayanthi	Commencement of Ramzan.
ma ...		
i ...	Sri Ramanujacharya Thirunakshatra	
a ...	Sri Shankaracharya Jayanthi	
a ...	Bharani rain, 4th pada	
hi ...	Krithika rain, 1st pada	
va ...		
nata ...		
na ...	Ekadasi for all.	
...	Vrishabha Sankaramanna	
i ...	Krithika rain, 2nd pada	
patha ...		
an-Parigha ...	Vyasapoornima, Krithika rain, 3rd pada and Buddha Purnima	
JLA		
...		
a ...		
a ...	Krithika rain, 4th pada	
a ...		
a ...		
...		
ma ...		
...	Rohini rain, 1st pada	
riti-Vishkamba		
i ...		
hman ...	Ekadasi for all.	
hagya ...		
nana ...		
nda ...		

Holidays	English Date	Days of the weeks	Dates		Thithies in Ghaliges and Vighaliges	Nakshatras in Ghaliges and Vighaliges
			Chandra-mana	Sowra-mana		
						VAISHA
	1	Tuesday ...	30	19	● Amavasya 8 24	Rohini .. 36
						JYE
	2	Wednesday	1	20	Padyami ... 2 36 Bidige ... 57 0	Mrigasira ... 34
				Shawval		
M	3	Thursday...	2	21	Tadige ... 54 39	Aridra ... 31
	4	Friday ...	4	22	Chouthi ... 53 27	Punarvasu ... 30
	5	Saturday ...	5	23	Panchami ... 52 13	Pushya ... 31
	6	Sunday ...	6	24	Shasti .. 52 48	Aslesha ... 33
	7	Monday ...	7	25	Saptami ... 54 0	Makha ... 36
	8	Tuesday ...	8	26	Ashtami ... 56 24	Pubba ... 39
	9	Wednesday	9	27	Navami ... 60 0	Uttara ... 4
	10	Thursday...	9	28	Navami ... 1 13	Hasta ... 50
	11	Friday ...	10	29	Dasami ... 1 36	Chitta ... 5
	12	Saturday ...	11	30	Ekadasi ... 9 29	Swathi ... 6
	13	Sunday ...	12	31	Dwadasi ... 14 24	Swathi ...
	14	Monday ...	13	32	Trayodasi ... 18 39	Vishakha ...
				Mithuna or Ani		
	15	Tuesday ...	14	1	Chaturdasi ... 23 0	Anuradha ... 1
	16	Wednesday	15	2	○ Poornima... 26 1	Jyesta ... 1
						JYE
	17	Thursday...	1	3	Padyami ... 27 39	Moola ... 2
	18	Friday ...	2	4	Bidige ... 28 10	Poorvashadha 2
	19	Saturday ...	3	5	Tadige ... 27 1	Uttarashadha 2
	20	Sunday ...	4	6	Chouthi ... 25 14	Sravana ... 2
	21	Monday ...	5	7	Panchami ... 21 40	Dhanista ... 2
	22	Tuesday ...	6	8	Shashti ... 17 28	Satabhisha ... 2
	23	Wednesday	7	9	Saptami ... 13 15	Poorvabhadra 2
	24	Thursday...	8	10	Ashtami ... 7 10	Uttarabhadra 1
	25	Friday ...	9-10	11	Navami ... 1 12 Dasami ... 55 16	Revathi ... 1
	26	Saturday ...	11	12	Ekadasi ... 49 16	Aswini ...
	27	Sunday ...	12	13	Dwadasi ... 43 18	Bharani ...
	28	Monday ...	13	14	Trayodasi ... 37 38	Krithika ...
						Rohini ... 5
	29	Tuesday ...	14	15	Chaturdasi ... 32 27	Mrigasira ... 5
	30	Wednesday	30	16	● Amavasya... 26 18	Aridra ... 5

Yogams	Feasts, Festivals, Government Holidays and Rainfall according to Nakshatras	Date of Cattle Fairs, Cattle Shows, Agricultural Exhibitions and other useful notes
AHULA		Sunrise 5-57 A.M.
ukarma ...		
UDDHA		
hriti ...		
hoola ...	Kutba-e-Ramzan	Commencement of Shavval
anda-Vriddhi ...	Rohini rain, 4th pada	
ruva ...		
yagatha ...		
arsha ...		
ajra ...	Mrigasira rain, 1st pada	
ddhi ...		
yathipatha ...		
ariyan ...	Mrigasira rain, 2nd pada	
arigha ...	Ekadasi	
va ...		
ddha ...		
adhya ...	Mrigasira rain, 3rd pada	
ubha ...	Mithuna Sankramana	
AHULA		
ukla ...		
rahma ...		
udra ...		
aidriti ...		
ishkamba ...		
reethi ...	Aridra rain, 1st pada	
yushman ...		
owbhagya ...		
hobhana, Atiganda...		
ukarma ...	Smartha Ekadasi	
hriti ...		
hoola ...		
anda ...	Aridra rain, 3rd pada	
riddhi ...	Amavasya for all	Solar Eclipse.

Holidays	English Dates	Days of the week	Dates: Chandramana	Dates: Sowramana	Thithies in Ghaliges and Vighaliges	Nakshatras in Ghaliges and Vighaliges
						ASHADHA
	1	Thursday...	1	17	Padyami ... 24 37	Punarvasu ... 51 0
					Zikhaida	
	2	Friday ...	2	18	Bidige ... 22 13	Pushya ... 51 10
	3	Saturday ...	3	19	Tadige ... 21 10	Aslesha ... 52 12
	4	Sunday ...	4	20	Chouthi ... 21 16	Makha ... 54 3
	5	Monday ...	5	21	Panchami ... 22 12	Pubba ... 58 1
	6	Tuesday ...	6	22	Shasti ... 25 15	Uttara ... 60
	7	Wednesday	7	23	Saptami ... 28 48	Uttara ... 3 0
	8	Thursday...	8	24	Ashtami ... 33 39	Hastha ... 9 1
	9	Friday ...	9	25	Navami ... 38 26	Chitta ... 15 1
	10	Saturday ...	10	26	Dasami ... 43 10	Swathi ... 21 3
	11	Sunday ...	11	27	Ekadasi ... 48 0	Vishakha ... 27 3
	12	Monday ...	12	28	Dwadasi ... 51 36	Anuradha ... 33 3
	13	Tuesday ...	13	29	Trayodasi ... 54 37	Jyesta ... 38 2
	14	Wednesday	14	30	Chaturdasi ... 55 49	Moola ... 42
	15	Thursday...	15	31	○ Poornima 57 0	Poorvashada 44 2
						ASHADHA
					Kataka or Adi	
	16	Friday ...	1	1	Padyami ... 56 1	Uttarashada 43 4
	17	Saturday ...	2	2	Bidige ... 54 10	Sravana ... 45 3
	18	Sunday ...	3	3	Tadige ... 50 27	Dhanista ... 45
	19	Monday ...	4	4	Chouthi ... 46 12	Sathabhisha ... 43 1
	20	Tuesday ...	5	5	Panchami ... 42 0	Poorvabhadra 40 1
G	21	Wednesday	6	6	Shasti ... 36 15	Uttarabhadra 36 1
	22	Thursday...	7	7	Saptami ... 30 16	Revati ... 33 1
	23	Friday ...	8	8	Astami ... 24 39	Asvini ... 29
	24	Saturday ...	9	9	Navami ... 18 36	Bharani ... 24 3
	25	Sunday ...	10	10	Dasami ... 15 40	Krithika ... 20 2
	26	Monday ...	11	11	Ekadasi ... 7 10	Rohini ... 16 4
	27	Tuesday ...	12-13	12	Dwadasi ... 21	Mrigasira ... 14
					Trayodasi ... 57 10	
	28	Wednesday	14	13	Chaturdasi ... 53 31	Aridra ... 12 1
	29	Thursday...	30	14	● Amavasya 51 10	Punarvasu ... 10 1
						SRAVANA
	30	Friday ...	1	15	Padyami 49 12	Pushya ... 10 1
	31	Saturday ...	2	16	Bidige 49 12	Aslesha ... 10 4

Yogams	Feasts, Festivals, Government Holidays and Rainfall according to Nakshatras	Dates of Cattle Fairs, Cattle Shows, Agricultural Exhibitions and other useful notes
JDDHA		Sunrise 6-1 A.M.
nruva ...		
vagatha ...	Aridra rain, 4th pada	Commencement of Zikhaida.
arsha ...		
ajra ...		
ddhi ...		
athipatha ...	Punarvasu rain, 1st pada	
riyan ...		
righa ...		
va ...		
ldha ...	Punarvasu rain, 2nd pada	
dya ...	Ekadasi for all,	
bha ...		
kla ...	Punarvasu rain, 3rd pada	
ahma ...		
dra ...	Vyasa Purnima and Lunar Eclipse	
SHULA		
idrithi ...	Punarvasu rain, 4th pada	Dakshinayana Punyakala
shkamba ...		
eeti-Ayushman ...		
wbhagya ...		
obhana ...	Pushya rain, 1st pada	Tikacharyara Punyadivasa
iganda ...	Krishnarajamudi, Melkote	H.H. Rajapramuk's Birthday
karma ...		
riti ...	Pushya rain, 2nd pada	
oola ...		
nda ...		
iddhi ...	Ekadasi for all.	
uva-Vyagatha ...		
rsha ...		
jra ...	Bhima Amavasya	
DDHA		
ldhi ...	Pushya rain, 4th pada	
athipatha ...		

Holidays	English Dates	Days of the week	Dates: Chandramana	Dates: Sowramana	Thithies in Ghaliges and Vighaliges			Nakshatras in Ghaliges and Vighaliges		
										SRAVANA
				Zilhaj						
	1	Sunday ...	3	17	Tadige	... 51	5	Makha	... 13	15
	2	Monday ...	4	18	Chouthi	... 54	10	Pubba	... 16	50
	3	Tuesday ...	5	19	Panchami	... 57	5	Uttara	... 21	37
	4	Wednesday	6	20	Shasti	... 60	0	Hasta	... 27	0
	5	Thursday...	6	21	Shasti	... 1	45	Chitta	... 33	10
	6	Friday ...	7	22	Saptami	... 6	36	Swathi	... 36	0
	7	Saturday ...	8	23	Ashtami	... 12	10	Vishakha	... 40	12
	8	Sunday ...	9	24	Navami	... 16	16	Anuradha	... 50	0
	9	Monday ...	10	25	Dasami	... 20	26	Jyesta	... 57	12
M	10	Tuesday ...	11	26	Ekadasi	... 23	24	Moola	... 60	0
	11	Wednesday	12	27	Dwadasi	... 25	13	Moola	... 0	15
	12	Thursday...	13	28	Trayodasi	... 26	26	Poorvashadha	3	36
	13	Friday ...	14	29	Chaturdasi	... 25	10	Uttarashadha	4	48
G	14	Saturday ...	15	30	○ Poornima	23	27	Sravana	... 6	10
										SRAVANA
	15	Sunday ...	1	31	Padyami	... 20	27	Dhanista	... 4	48
	16	Monday ...	2	32	Bidige	... 16	49	Sathabhisha	... 3	0
				Simha or Avni						
	17	Tuesday ...	3	1	Tadige	... 12	0	Poorvabhadra	2	58
								Uttarabhadra	56	30
	18	Wednesday	4	2	Chouthi	... 6	30	Revathi	... 53	0
	19	Thursday...	5-6	3	Panchami	... 0	34	Aswini	... 49	10
					Shasti	... 54	53			
	20	Friday ...	7	4	Saptami	... 48	37	Bharani	... 45	0
	21	Saturday ...	8	5	Ashtami	... 42	39	Krithika	... 41	10
	22	Sunday ...	9	6	Navami	... 36	37	Rohini	... 37	1
	23	Monday ...	10	7	Dasami	... 31	16	Mrigasira	... 34	10
	24	Tuesday ...	11	8	Ekadasi	... 27	18	Aridra	... 31	5
	25	Wednesday	12	9	Dwadasi	... 23	30	Punarvasu	... 30	
	26	Thursday...	13	10	Trayodasi	... 21	18	Pushya	... 29	48
	27	Friday ...	14	11	Chaturdasi	... 20	24	Aslesha	... 30	10
	28	Saturday ...	30	12	● Amavasya	20	27	Makha	... 31	4
										BHADRAPADA
	29	Sunday ...	1	13	Padyami	... 21	0	Pubba	... 35	30
				Muharram						
	30	Monday ...	2	14	Bidige	... 23	28	Uttara	... 39	4
H	31	Tuesday ...	3	15	Tadige	... 27	41	Hasta	... 45	

Yogams	Feasts, Festivals, Government Holidays and Rainfall according to Nakshatras	Dates of Cattle Fairs, Cattle Shows, Agricultural Exhibitions and other useful notes
DHA		Sunrise 6-9 A.M.
yan ...		Commencement of Zilhaj
gha ...		
...	Aslesha rain, 1st pada Garudapanchami	
ha ...		
iya ...		
ia ...	Aslesha rain, 2nd pada	
a ...		
ima ...		
a ...		
rithi ...	Aslesha rain, 3rd pada	
kamba ..	[Bakrid	
thi ...		
shman ...	Aslesha rain, 4th pada	Varamahalaxmi vratam.
bhagya ...	Upakarma (Aswalayana)	
ULA		
bana ...	Gayathri	Independence Day
anda ...		
arma-Dhriti ..	Makha rain, 1st pada Sumha Sankramana	
ola ...		
da ...		
dhi ...	Makha rain, 2nd pada	
va ...	Mannar Sri Krishna Jayanti	
gatha ...	Tholappar Sri Krishna	
sha ...	Jayanthi	
a ...	Makha rain, 3rd pada	
hi ...		
thipatha ...		
yan ...	Makha rain, 4th pada	
gha ...	Amavasya for all.	
DHA		
...		
hi ...		Commencement of
a ..	Pubba rain, 1st pada Gouri feast. Samopakrma	Muharram

Holidays	English Date	Days of the weeks	Dates: Chandra-mana	Dates: Sowra-mana	Thithies in Ghaliges and Vighaliges	Nakshatras in Ghaliges and Vighaliges
						BHADRAPAD
G	1	Wednesday	4	16	Chouthi ... 30 29	Chitta ... 51 1
	2	Thursday...	5	17	Panchami ... 37 50	Swathi ... 57 2
	3	Friday ...	6	18	Shasti ... 42 39	Vishakha ... 60
	4	Saturday ...	7	19	Saptami ... 47 31	Vishakha ... 4 1
	5	Sunday ...	8	20	Ashtami ... 51 37	Anuradha ... 10 2
	6	Monday ...	9	21	Navami ... 54 0	Jyesta ... 15
	7	Tuesday ...	10	22	Dasami ... 55 48	Moola ... 19 1
G	8	Wednesday	11	23	Ekadasi ... 57 10	Poorvashadha 22 1
	9	Thursday...	12	24	Dwadasi ... 56 29	Uttarashadha 24 3
	10	Friday ...	13	25	Trayodasi ... 54 36	Sravana ... 25
	11	Saturday ...	14	26	Chaturdasi ... 51 40	Dhanista ... 21 3
	12	Sunday ...	15	27	○ Poornima . 48 10	Satabhisha ... 22 4
						BHADRAPAD
	13	Monday ...	1	28	Padyami ... 43 18	Poorvabhadra 20 2
	14	Tuesday ...	2	29	Bidige ... 38 37	Uttarabhadra 17 4
	15	Wednesday	3	30	Tadige ... 31 49	Revathi ... 13 4
	16	Thursday...	4	31	Chouthi ... 25 51	Aswini ... 9 3
				Kan	ya or Peritashi	
	17	Friday ...	5	1	Panchami ... 19 49	Bharani ... 5 5
	18	Saturday ...	6	2	Shashti ... 14 0	Krithika ... 1 1
						Rohini ... 57 3
	19	Sunday ...	7	3	Saptami ... 8 31	Mrigasira ... 54
	20	Monday ...	8-9	4	Ashtami ... 0 18	Aridra ... 51 3
					Navami ... 59 4	
	21	Tuesday ...	10	5	Dasami ... 55 50	Punarvasu ... 49 5
	22	Wednesday	11	6	Ekadasi ... 53 32	Pushya ... 49
	23	Thursday...	12	7	Dwadasi ... 52 16	Aslesha ... 49 4
	24	Friday ...	13	8	Trayodasi ... 51 32	Makha ... 51 3
	25	Saturday ...	14	9	Chaturdasi ... 53 27	Pubba ... 54 3
	26	Sunday ...	30	10	● Amavasya... 56 26	Uttara ... 58 1
						ASVI
	27	Monday ...	1	11	Padyami ... 60 0	Hasta ... 60
G	28	Tuesday ...	1	12	Padyami ... 0 25	Hasta ... 0 3
				Saffar		
	29	Wednesday	2	13	Bidige ... 2 30	Chittra ... 8 4
	30	Thursday...	3	14	Tadige ... 10 5	Swathi ... 15 2

Yogams	Feasts, Festivals, Government Holidays and Rainfall according to Nakshatras	Date of Cattle Fairs, Cattle Shows, Agricultural Exhibitions and other useful notes
DDHA		Sunrise 6-12 A.M.
bha ...	Vinayaka vratha (Genesha)	
la ...		
hma ...	Pubba rain, 2nd pada	
ra ...		
driti ...		
hkamba ...	Pubba rain, 3rd pada	
ethi ...		
shman-Sowbhagya	Last day of Muharram	
bhana ...		
ganda ...	Pubba rain, 4th pada	
arma ...	Ananthapadmanabha Chaturdasi	
riti ...		
HULA		
ola ...	Uttara rain, 1st pada	
nda ...	Pitru Paksha	
ddhi ...		
va-Vyaghta ...		
rsha ...	Uttara rain, 2nd pada	
ra ...	Kanya Sankramana Punyakala	
dhi ...	Madyastami	
athipatha ...	Avidhava Navami	
	Uttara rain, 3rd pada	
iyan ...		
igha ...	Ekadasi for all	
a ...	Uttara rain, 4th pada	
dha ...		
lya ...		
bha ...	Amavasya for all Hasta rain, 1st pada	Mahalaya Amavasya.
DDHA		
la ...	Navaratri	Commencement of Dasara.
hma ...		
ra ...		
lrithy ...		

Holidays	English Dates	Days of the week	Dates: Chandramana	Dates: Sowramana	Thithies in Ghaliges and Vighaliges			Nakshatras in Ghaliges and Vighaliges		
										Asvij
	1	Friday ...	4	15	Chouthi	... 15	10	Vishakha	... 22	
G	2	Saturday ...	5	16	Panchami	... 19	48	Anuradha	... 28	
	3	Sunday ...	6	17	Shasti	... 24	1	Jyesta	... 33	
	4	Monday ...	7	18	Saptami	... 27	11	Moola	... 39	
	5	Tuesday ...	8	19	Ashtami	... 28	52	Poorvashada	41	
G	6	Wednesday	9	20	Navami	... 30	10	Uttarashada	44	
G	7	Thursday ...	10	21	Dasami	... 29	47	Sravana	... 44	
	8	Friday ...	11	22	Ekadasi	... 27	39	Dhanista	... 43	
	9	Saturday ...	12	23	Dwadasi	... 25	20	Sathabhisha	... 42	
	10	Sunday ...	13	24	Trayodasi	... 21	36	Poorvabhadra	40	
	11	Monday ...	14	25	Chaturdasi	... 17	0	Uttarabhadra	37	
	12	Tuesday ...	15	26	○ Poornima	11	28	Revati	... 31	
										Asvi
	13	Wednesday	1	27	Padyami	... 6	11	Asvini	... 29	
	14	Thursday ...	2-3	28	Bidige	... 0	10	Bharani	... 25	
					Tadige	... 54	1			
	15	Friday ...	4	29	Chouthi	... 48	10	Krithika	... 21	
	16	Saturday ...	5	30	Panchami	... 42	39	Rohini	... 18	
				Tula or Alpisi						
	17	Sunday ...	6	1	Shasti	... 37	50	Mrigasira	... 14	
	18	Monday ...	7	2	Saptami	... 33	42	Aridra	... 11	
	19	Tuesday ...	8	3	Astami	... 30	14	Punarvasu	... 9	
	20	Wednesday	9	4	Navami	... 28	19	Pushya	... 8	
	21	Thursday ...	10	5	Dasami	... 27	0	Aslesha	... 9	
	22	Friday ...	11	6	Ekadasi	... 27	24	Makha	... 10	
	23	Saturday ...	12	7	Dwadasi	... 28	49	Pubba	... 12	
	24	Sunday ...	13	8	Trayodasi	... 31	51	Uttara	... 16	
G	25	Monday ...	14	9	Chaturdasi	... 35	30	Hastha	... 21	
	26	Tuesday ...	30	10	● Amavasya	39	31	Chitta	... 27	
										Karthi
G	27	Wednesday	1	11	Padyami	45	9	Swathi	... 33	
	28	Thursday ...	2	12	Bidige	50	28	Vishakha	... 38	
				Rabi-ul-Avval						
	29	Friday ...	3	13	Tadige	... 55	49	Anuradha	... 46	
	30	Saturday ...	4	14	Chouthi	... 59	27	Jyesta	... 51	
	31	Sunday ...	5	15	Panchami	... 60	0	Moola	.. 56	

Yogams	Feasts, Festivals, Government Holidays and Rainfall according to Nakshatras	Dates of Cattle Fairs, Cattle Shows, Agricultural Exhibitions and other useful notes
DDHA		Sunrise 6-12 A.M.
hkamba ...		
eti ...	Mahathma Gandhi's Birthday	
ushman ...		
vbhagya ...	Hasta rain, 3rd pada Sarasvathi Avahani	
bhana ...	Durgashtami	
ganda ...	Ayudha-pooja Mahanavami	
karma ...	Vijaya Dasami, Vedanta	Char Thirunakshatram
riti-Shoola ...	Hasta rain, 4th pada	
nda ...		
ddhi ...		
uva ...	Chitta rain, 1st pada	
agatha ...		
HULA		
rsha ...		
ra ...	Chitta rain, 2nd pada	
dhi ...		
attipatna ...		
riyan ...	Chitta rain, 3rd pada	
igna-Siva ...	Tulasankramana	
dha ...		
lya ...	Chitta rain, 4th pada	
bha ...		
kla ...	Ekadasi for all.	
hma ...		
ra ...	Swathi rain, 1st pada	
drithi ...	Narakachaturdasi & Deepa-	
hkamba ...	Amavasya for all [vali	
DDHA		
eti ...	Balipadyami, Swathi rain, 2nd pada	Akhiri Charshumba
ushman ...		
vbhagya ...		
bhana ...	Swathi rain, 3rd pada	
ganda ...		

Holidays	English Dates	Days of the week	Dates Chandra-mana	Dates Sowra-mana	Thithies in Ghaliges and Vighaliges	Nakshatras in Ghaliges and Vighaliges
						KARTHIKA
	1	Monday ...	5	16	Panchami ... 0 12	Poorvashadha 60
	2	Tuesday ...	6	17	Shasti ... 0 21	Poorvashadha 0
	3	Wednesday	7	18	Saptami ... 0 28	Uttarashadha 0 1
	4	Thursday...	8	19	Ashtami ... 0 24	Sravana ... 0 1
	5	Friday ...	9	20	Navami ... 0 18	Dhanista ... 0 2
	6	Saturday ...	10-11	21	Dasami ... 0 6 Ekadasi ... 57 0	Sathabhisha ... 0 1
	7	Sunday ...	12	22	Dwadasi ... 50 25	Poorvabhadra 0 Uttarabhadra 58
	8	Monday ...	13	23	Trayodasi ... 47 8	Revathi ... 54
M	9	Tuesday ...	14	24	Chaturdasi ... 41 24	Aswini ... 50 2
	10	Wednesday	15	25	○ Poornima 36 0	Bharani ... 46 1
						KARTHIKA
	11	Thursday...	1	26	Padyami ... 30 10	Krithika ... 42 1
	12	Friday ...	2	27	Bidige ... 24 14	Rohini ... 39 4
	13	Saturday ...	3	28	Tadige ... 18 16	Mrigasira ... 34 1
	14	Sunday ...	4	29	Chouthi ... 14 29	Aridra ... 31 4
	15	Monday ...	5	30	Panchami ... 10 11	Punarvasu ... 28 5
				Vri	chika or Kartikai	
	16	Tuesday ...	6	1	Shasti ... 5 39	Pushya ... 28 1
	17	Wednesday	7	2	Saptami ... 0 21	Aslesha ... 28 1
	18	Thursday...	8	3	Ashtami ... 0 18	Makha ... 28 3
	19	Friday ...	9	4	Navami ... 0 21	Pubba ... 31 1
	20	Saturday ...	10	5	Dasami ... 0 27	Uttara ... 34 4
	21	Sunday ...	11	6	Ekadasi ... 7 30	Hasta ... 39 3
	22	Monday ...	12	7	Dwadasi ... 12 0	Chitta ... 45 3
	23	Tuesday ...	13	8	Trayodasi ... 17 26	Swathi ... 51 3
	24	Wednesday	14	9	Chaturdasi ... 22 12	Vishakha ... 57 3
	25	Thursday...	30	10	● Amavasya 27 0	Anuradha ... 60
						MARGASIRA
	26	Friday ...	1	11	Padyami ... 31 49	Anuradha ... 0 2
	27	Saturday ...	2	12	Bidige ... 36 37	Jyesta ... 10 1
				Rab	i-us-Sani	
	28	Sunday ...	3	13	Tadige ... 40 16	Moola ... 15 1
	29	Monday ...	4	14	Chouthi ... 42 10	Poorvashadha 19 1
	30	Tuesday ...	5	15	Panchami ... 43 50	Uttarashadha 21 3

Yogams	Feasts, Festivals, Government Holidays and Rainfall according to Nakshatras	Dates of Cattle Fairs, Cattle Shows, Agricultural Exhibitions and other useful notes
DDHA		Sunrise 6-14 A.M.
tarma ...		
riti ...		
ola ...	Swathi rain, 4th pada	
hda ...		
ddha ...		
ruva-Vyaghatha ...	Vishakha rain, 1st pada	
rsha ...		
ra ...		
dhi ...		
athipatha ...	Vishakha rain, 2nd pada	Id Meelad
HULA		
iyan ...		
igha ...		
a ...	Vishakha rain, 3rd pada	
dha ...		
lya ...		
bha ..	Vishakha rain, 4th pada	
kla ...	Virchika Sankramana	
ahma ...		
ra ...	Anuradha rain, 1st pada	
idhriti ...		
hkamba ...	Ekadasi for all	
eti ...		
ushman ...	Anuradha rain, 2nd pada	
vbhagya ...		
bhana-Atiganda ...		
DDHA		
arma ...		
riti ...		
ola ...		
da ...		
ddhi ...		

Holidays	English Dates	Days of the week	Dates: Chandra-mana	Dates: Sowra-mana	Thithies in Ghaliges and Vighaliges	Nakshatras in Ghaliges and Vighaliges
						MARGASIRA
	1	Wednesday	6	16	Shashti ... 42 38	Sravana ... 22 49
	2	Thursday...	7	17	Sapthami ... 40 51	Dhanishta ... 23 26
	3	Friday ...	8	18	Ashtami ... 37 45	Satabhisha ... 22 48
	4	Saturday ...	9	19	Navami ... 32 12	Poorvabhadra 20 26
	5	Sunday ...	10	20	Dasami ... 30 31	Uttarabhadra 18 12
	6	Monday ...	11	21	Ekadasi ... 24 36	Revati ... 14 28
	7	Tuesday ...	12	22	Dwadasi ... 19 12	Asvini ... 10 49
	8	Wednesday	13	23	Trayodasi ... 13 16	Bharani ... 6 33
	9	Thursday...	14	24	Chaturdasi ... 7 14	Krithika ... 0 1
						Rohini ... 58 12
	10	Friday ...	15-1	25	O Poornima.. 0 10	Mrigasira ... 54 40
					Padyami ... 55 50	
						MARGASIRA
	11	Saturday ...	2	26	Bidige ... 51 31	Aridra ... 51 4
	12	Sunday ...	3	27	Tadige ... 47 28	Punarvasu ... 49 1
	13	Monday ...	4	28	Chouthi ... 43 49	Pushya ... 48
	14	Tuesday ...	5	29	Panchami ... 42 37	Aslesha ... 43 4
	15	Wednesday	6	30	Shasti ... 48 6	Makha ... 48
				Dha	nus or Margali	
	16	Thursday...	7	1	Sapthami ... 42 38	Pubba ... 49 1
	17	Friday ...	8	2	Ashtami ... 44 26	Uttara ... 53 2
	18	Saturday ...	9	3	Navami ... 47 28	Hasta ... 58 1
	19	Sunday ...	10	4	Dasami ... 51 0	Chitta ... 60
	20	Monday ...	11	5	Ekadasi ... 55 5	Chittra ... 0 1
	21	Tuesday ...	12	6	Dwadasi ... 60 0	Swathi ... 9 3
	22	Wednesday	12	7	Dwadasi ... 0 24	Vishakha ... 16 1
	23	Thursday...	13	8	Trayodasi ... 6 39	Anuradha ... 22 4
	24	Friday ...	14	9	Chaturdasi ... 11 29	Jyesta ... 28 4
G	25	Saturday ..	30	10	● Amavasya 15 38	Moola ... 33 3
						PUSHY
	26	Sunday ...	1	11	Padyami ... 18 30	Poorvashada... 37 5
				Jam	adi-ul-Auval	
	27	Monday ...	2	12	Bidige ... 21 5	Uttarashada ... 41 4
	28	Tuesday ...	3	13	Tadige ... 22 13	Sravana ... 42 3
	29	Wednesday	4	14	Chouthi ... 20 5	Dhanishta ... 42 3
	30	Thursday ...	5	15	Panchami ... 19 48	Satabhishta ... 42
	31	Friday ...	6	16	Shashti ... 16 48	Poorvabhadra 40 1

Yogams	Feasts, Festivals, Government Holidays and Rainfall according to Nakshatras	Dates of Cattle Fairs, Cattle Shows, Agricultural Exhibitions and other useful notes
DDHA		Sunrise 6-23 A.M.
ruva ...	Skandashasti, Champa shasti	Subrahmanyaswami Car festival, Chetravathi, Erulappa Jatre cattle show
aghata ...		
rsha ...	Jyesta rain, 1st pada	
jra ...		
dhi ...		
atipatha-Variyan ...	Jyesta rain, 2nd pada Ekadasi for all.	
righa ...		
a ...		
dha ...	Jyesta rain, 3rd pada	
lya ...		
HULA		
bha ...	Jyesta rain, 4th pada	
kla ...		
ahma ...		
ira ...		
idhriti ...		
shkamba-Preeti ...	Dhanurmasa Sankramana	
ushman ...	Moola rain, 1st pada	Cattle show at (1) Vokkaleri, Kolar Tk, (2) Chennagiri Town, (3) Haribar Town (4) Bettadapur, Hunsur Tk, (5) Anthraghatta, Kadur Tk. (6) ThalakailBetta, SidlaghattaTk, (7) Vasanthpura, Bangalore Tk.
wbhagya ...	Moola rain, 2nd pada	
obhana ...		
ganda ...		
karma ...	Ekadasi for all.	
riti ...	Moola rain, 3rd pada	
oola ...		
nda ...	Amavasya for all.	
iddhi ...	Moola rain, 4th pada	Christmaas & Solar Eclipse.
DDHA		
ruva ...		
aghata ...		
rsha ...	Poorvasbadha rain, 1st pada	
jra ...		
ldhi ...		
atipatha ...		

Holidays	English Dates	Days of the week	Dates: Chandramana	Dates: Sowramana	Thithies in Ghaliges and Vighaliges			Nakshatras in Ghaliges and Vighaliges		
										PUSHYA
G	1	Saturday ...	7	17	Saptami	... 13	14	Uttarabhadra	37	3
	2	Sunday ...	8	18	Ashtami	... 8	24	Revati	... 34	1
	3	Monday ...	9-10	19	Navami	... 0	50	Asvini	... 30	3
					Dasami	... 54	29			
	4	Tuesday ...	11	20	Ekadasi	... 50	17	Bharani	... 27	
	5	Wednesday	12	21	Dwadasi	... 45	42	Krithika	... 22	4
	6	Thursday ...	13	22	Trayodasi	... 40	16	Rohini	... 18	3
	7	Friday ...	14	23	Chaturdasi	... 35	0	Mrigasira	... 15	1
	8	Saturday ...	15	24	○ Poornima	30	31	Aridra	... 12	3
										PUSHYA
	9	Sunday ...	1	25	Padyami	... 26	26	Punarvasu	... 9	3
	10	Monday ...	2	26	Bidige	... 23	29	Pushya	... 7	5
	11	Tuesday ...	3	27	Tadige	... 21	39	Aslesha	... 6	4
	12	Wednesday	4	28	Chouthi	... 21	0	Makha	... 7	1
	13	Thursday...	5	29	Panchami	... 21	15	Pubba	... 9	4
				Makara or Tai						
G	14	Friday ...	6	1	Shasti	... 23	0	Uttara	... 12	2
	15	Saturday ...	7	2	Saptami	... 25	49	Hastha	... 16	1
	16	Sunday ...	8	3	Astami	... 30	16	Chitta	... 21	3
	17	Monday ...	9	4	Navami	... 35	42	Swathi	... 27	3
	18	Tuesday ...	10	5	Dasami	... 40	49	Vishakha	... 34	1
	19	Wednesday	11	6	Ekadasi	... 46	13	Anuradha	... 40	3
	20	Thursday...	12	7	Dwadasi	... 51	0	Jyesta	... 46	5
	21	Friday ...	13	8	Trayodasi	... 54	36	Moola	... 51	3
	22	Saturday ...	14	9	Chaturdasi	... 58	0	Poorvashada	56	2
	23	Sunday ...	30	10	● Amavasya	60	0	Uttarashada	59	1
	24	Monday ...	30	11	● Amavasya	1	15	Sravana	... 60	
										MAGHA
	25	Tuesday ...	1	12	Padyami	0	10	Sravana	... 0	3
					Bidige	59	0			
	26	Wednesday	2	13	Tadige	... 58	12	Dhanista	... 0	2
	27	Thursday...	3	14	Chouthi	... 55	16	Sathabhisha	... 0	1
	28	Friday ...	4	15	Panchami	... 51	0	Poorvabhadra	0	1
								Uttarabhadra	58	1
	29	Saturday ...	5	16	Shasti	... 48	14	Revati	... 55	1
	30	Sunday ...	6	17	Saptami	... 42	5	Asvini	... 51	3
	31	Monday ...	7	18	Astami	... 36	36	Bharani	... 47	4

Yogams	Feasts, Festivals, Government Holidays and Rainfall according to Nakshatras	Dates of Cattle Fairs, Cattle Shows, Agricultural Exhibitions and other useful notes
ODHA		Sunrise 6-44 A.M.
iyan ...	Poorvashadha rain, 2nd pada	Cattle show at Hassan Town.
igha ...		
ı ...		
lha-Sadhya ...	Poorvashadha rain, 3rd pada	
ha ...		
la ...		
hma ...		
ra ...	Poorvashada rain, 4th pada	Lunar Eclipse.
HULA		
drithi ...		
hkamba ...		
ethi ...	Uttarashada rain, 1st pada	
ıshman ...		
ybhagya ...	Uttarashada rain, 2nd pada	
bana ...	Uttarayana-Makara Sankranthi	
ganda ...		
arma ...	Uttarashada rain, 3rd pada	(1) Sivganga, Nelamangala Tk.
iti ...		(2) Nagalamudeke, Pavagada Tk.
ola ...		(3) Hemmegepura, Anekal Tk.
ıda ...	Uttarashada rain, 4th pada	(4) Chunchanakatte, YedathoreTk.
ddhi ...		(5) Hemagiri, Krishnarajapet Tk.
ıva ...	Sravana rain, 1st pada	
agatha ...		
rsha ...		
ra ...		
ODHA		
dhi ...		
thipatha ...	Sravana rain, 2nd pada	
iyan ...		
igha ...		
ı ...		
dhi ...		
ya ...		

Holidays	English Date	Days of the week	Dates: Chandra-mana	Dates: Sowra-mana	Thithies in Ghaliges and Vighaliges	Nakshatras in Ghaliges and Vighaliges
						MAGHA
	1	Tuesday ...	9	19	Navami ... 30 10	Krithika ... 42 26
	2	Wednesday	10	20	Dasami ... 24 5	Rohini ... 39 6
	3	Thursday...	11	21	Ekadasi ... 18 36	Mrigasira ... 36 0
	4	Friday ...	12	22	Dwadasi ... 12 39	Aridra ... 31 50
	5	Saturday ...	13	23	Trayodasi ... 7 48	Punarvasu ... 29 26
	6	Sunday ...	14	24	Chaturdasi ... 1 31	Pushya ... 27 39
	7	Monday ...	15	25	○ Poornima... 0 30	Aslesha ... 26 27
						MAGHA
	8	Tuesday ...	1-2	26	Padyami ... 1 0 Bidige ... 59 24	Makha ... 27 0
	9	Wednesday	3	27	Tadige ... 59 3	Pubba ... 27 38
	10	Thursday...	4	28	Chouthi ... 60 0	Uttara ... 30 24
	11	Friday ...	4	29	Chouthi ... 0 45	Hasta ... 34 50
	12	Saturday ...	5	30	Panchami ... 2 5	Chittra ... 39 39
					Kumba or Masi	
	13	Sunday ...	6	1	Shasti ... 9 31	Swathi ... 45 36
	14	Monday ...	7	2	Saptami ... 13 51	Vishakha ... 52 13
	15	Tuesday ...	8	3	Ashtami ... 18 30	Anuradha ... 54 39
	16	Wednesday	9	4	Navami ... 24 5	Jyesta ... 60 0
	17	Thursday...	10	5	Dasami ... 24 49	Jyesta ... 0 36
	18	Friday ...	11	6	Ekadasi ... 33 0	Moola ... 10 11
	19	Saturday ...	12	7	Dwadasi ... 36 3	Poorvashadha 15 0
	20	Sunday ...	13	8	Trayodasi ... 36 31	Uttarashadha 15 36
G	21	Monday ...	14	9	Chaturdasi ... 37 51	Sravana ... 21 10
	22	Tuesday ...	30	10	● Amavasya... 39 51	Dhanista ... 21 24
						PHALGUN
	23	Wednesday	1	11	Padyami ... 36 30	Satabhisha ... 20 36
	24	Thursday...	2	12	Bidige ... 32 39	Poorvabhadra 20 24
	25	Friday ...	3	13	Tadige ... 26 15	Uttarabhadra 18 36
	26	Saturday ...	4	14	Chouthi ... 23 29	Revathi ... 15 37
	27	Sunday ...	5	15	Panchami ... 18 0	Aswini ... 12 0
	28	Monday ...	6	16	Shasti ... 12 24	Bharani ... 7 48

Yogams	Feasts, Festivals, Government Holidays and Rainfall according to Nakshatras	Dates of Cattle Fairs, Cattle Shows, Agricultural Exhibitions and other useful notes
DHA		Sunrise 6-48 A.M.
ha ...	Madhvanavami	
la ...	Sravana rain, 4th pada	
hma-Indra ...	Bhishma Ekadasi	
dhriti ...		
kamba ...		
eti ...	Dhanista rain, 1st pada	
ishman ...		
HULA		
bhagya ...		
bhana ...	Dhanista rain, 2nd pada	
ganda ...		
karma ...		
riti ...	Dhanista rain, 3rd pada	
ola-Ganda ...	Kumba Sankramana	
ddhi ...		
ruva ...		
aghatha ...	Dhanista rain, 4th pada	
rsha ...		
jra ...	Ekadasi	
ldhi ...		
athipatha ...		
riyan ...	Mahasivarathri	Satabhisha rain, 2nd pada
righa ...	Amavasya for all	
DDHA		
a ...		
ldha ...		
dya ...	Satabhisha rain, 3rd pada	
kla ...		
ahma ...		
dra ...		

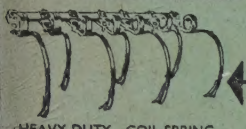
Holidays	English Dates	Days of the week	Dates: Chandra-mana	Dates: Sowra-mana	Thithies in Ghaliges and Vighaliges	Nakshatras in Ghaliges and Vighaliges
						PHALGUNA
	1	Tuesday ...	7	17	Saptami ... 7 20	Krithika ... 1 12 Rohini ... 58 30
	2	Wednesday	8-9	18	Ashtami ... 0 24 Navami ... 55 18	Mrigasira ... 54 31
	3	Thursday...	10	19	Dasami ... 49 39	Aridra ... 52 10
	4	Friday ...	11	20	Ekadasi ... 44 48	Punarvasu ... 49 16
	5	Saturday ...	12	21	Dwadasi ... 40 18	Pushya ... 46 51
	6	Sunday ...	13	22	Trayodasi ... 37 39	Aslesha ... 46 12
	7	Monday ...	14	23	Chaturdasi ... 36 12	Makha ... 46 14
H	8	Tuesday ...	15	24	○ Poornima 35 28	Pubba ... 47 29
						PHALGUNA
	9	Wednesday	1	25	Padyami ... 36 5	Uttara ... 49 49
	10	Thursday...	2	26	Bidige ... 38 27	Hasta ... 52 48
	11	Friday ...	3	27	Tadige ... 41 24	Chitta ... 57 36
	12	Saturday ...	4	28	Chouthi ... 45 39	Swathi ... 60 0
	13	Sunday ...	5	29	Panchami ... 50 19	Swathi ... 1 3
				Mee	na or Panguni	
	14	Monday ...	6	1	Shasti ... 55 10	Vishakha ... 10 12
	15	Tuesday ...	7	2	Saptami ... 60 0	Anuradha ... 16 48
	16	Wednesday	7	3	Saptami ... 1 24	Jyesta ... 23 0
	17	Thursday...	8	4	Ashtami ... 2 8	Moola ... 22 49
	18	Friday ...	9	5	Navami ... 8 27	Poorvashadha 28 12
	19	Saturday ...	10	6	Dasami ... 11 29	Uttarashadha 37 10
	20	Sunday ...	11	7	Ekadasi ... 13 47	Sravana ... 39 3
	21	Monday ...	12	8	Dwadasi ... 13 35	Dhanista ... 40 4
	22	Tuesday ...	13	9	Trayodasi ... 13 10	Sathabhisha ... 40 4
	23	Wednesday	14	10	Chaturdasi ... 10 49	Poorvabhadra 40 1
	24	Thursday...	30	11	● Amavasya 7 48	Uttarabhadra 38 3
						MANMATHA CHAITRA
G	25	Friday ...	1-2	12	Padyami ... 1 10 Bidige ... 58 0	Revathi ... 35 24
	26	Saturday ...	3	13	Tadige ... 53 36	Aswini ... 31 49
	27	Sunday ...	4	14	Chouthi ... 47 28	Bharani ... 28 15
	28	Monday ...	5	15	Panchami ... 41 32	Krithika ... 24 8
	29	Tuesday ...	6	16	Shasti ... 35 30	Rohini ... 20 0
	30	Wednesday	7	17	Saptami ... 30 0	Mrigasira ... 15 39
	31	Thursday ...	8	18	Astami ... 26 19	Aridra ... 12 0

Yogams	Feasts, Festivals, Government Holidays and Rainfall according to Nakshatras	Date of Cattle Fairs, Cattle Shows, Agricultural Exhibitions and other useful notes
DDHA		Sunrise 6-40 A.M.
idriti ...		
hkamba ...		
eethi ...	Poorvabhadra rain, 1st pada	
ushman ...	Ekadasi for all	
vbhagya-Shobhana		
ganda ...		
karma ...	Poorvabhadra rain, 2nd pada	
riti ...	Holi feast. Kama Dahana	
HULA		
bola ...		
nda ...		
ddhi ...	Poorvabhadra rain. 3rd pada	
uva ...		
aghata ...		
rsha ...	Poorvabhadra rain, 4th pada, Meena Sankranthi	
jra ...		
ldhi ...		
athipatha ...		
riyan ...	Uttarabhadra rain, 1st pada	
righa ...		
a ...	Ekadasi for all	
ldha ...	Uttarabhadra rain, 2nd pada	
dya ...		
bha ...	Amavasya for all	
kla ...		
DDHA		
ahma-Indra ...	Lunar New Year's Day Ugadi feast	
drithy ...		
hkamba ...		
eethi ...	Uttarabhadra rain, 4th pada	
ushman ...		
vbhagya ...		
obhana ...		

THE JOHN DEERE 'M' TRACTOR

COMPLETE MECHANISATION WITH M-50 TOOL CARRIER

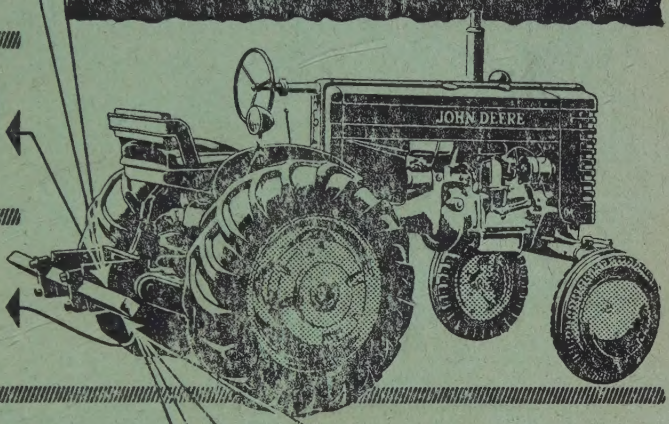
TWO-FURROW PLOUGH



HEAVY-DUTY COIL-SPRING CULTIVATOR ATTACHMENT

HEAVY-DUTY CHISEL CULTIVATOR ATTACHMENT

DITCHER ATTACHMENT



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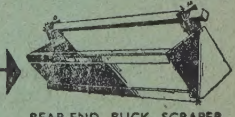
RIDGER ATTACHMENT



REAR-END BUCK SCRAPER ATTACHMENT

4-BLADE DISK ATTACHMENT

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